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By- Persons, Edgar A.; And Others

AN ECONOMIC STUDY OF THE INVESTMENT EFFECTS OF EDUCATION IN AGRICULTURE. FINAL REPORT.

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To determine the absolute economic return to adult farm business management education, the diminishing marginal return effect from added increments of education, and benefit-cost ratio of the educational program for participants and the sponsoring community, data were collected from 3,578 farm business records representing farmers enrolled in farm business management education in 1959-65. Farmers participating in the educational program were generally younger, better educated, and more affluent than the average farmer described in census data. Polynomial curvilinear regression statistical techniques describe the relationship between investment in farm business management education and three measures of economic success: farmer's labor earnings, return to capital and family labor, and total farm sales. Farmer's labor earnings and farm sales increased rapidly during the first three years of instruction, declined for the fourth, fifth, and sixth years and then increased rapidly in subsequent years. The benefit-cost ratio for individual farmer participants was 4.20:1. The community benefit-cost ratio when increased business activity was measured by increased farm sales was 9.00:1. This study assists in establishing a rationale for educational programs to increase community assets and describes an educational model for efficient program operation and growth. A summary of this study is available as VT 000 561. (DM)

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FINAL REPORT

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AN ECONOMIC STUDY OF THE INVESTMENT EFFECTS OF EDUCATION IN AGRICULTURE

Project No. OE 427-65
Grant No. OE 6-85-091

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April 1968

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FOREWORD

This study is one in a series of pioneering efforts to determine more precisely the outcomes of education. More specifically, it is an effort to describe the relationships between educational inputs and economic outcomes.

While the study is highly specific with reference to an adult education program in agriculture, it has relevance to the total field of education. It has special significance at this time when the benefit-cost ratios in educational endeavor are being raised for examination. In a way this study is a "natural" since it utilizes a source of data not heretofore available for researchers in agricultural education.

The authors of this report are to be commended for the new knowledge they have added to the field. As always, when one question is answered, several more spring up. In this from of reference, this study might well lay a claim to having a part in the knowledge explosion about which so much is said these days.

In any event, the results of this piece of research deserve the very special attention of all those responsible for conducting, planning, supervising and administering educational programs, particularly in the field of vocational-technical education.

Milo J. Peterson, Chairman
Department of Agricultural Education
University of Minnesota

SUMMARY

The precise returns to investments in education by farmers was examined within the framework of the farm business management education programs conducted by the public schools through vocational agriculture departments.

The inquiry was guided by the following questions: What benefits can accrue to farm families who choose to participate in an intensive, goal-oriented, educational program intended to improve their technical competence and management skills? What benefits accrue to the community that chooses to support such a program? What are the benefit-cost ratios of such an educational program when calculated for the individual participant and for the community? What is the educational and the economic relevance of the performance curves which describe the input-output relationships of the educational program outlined in this inquiry? What are the short-term and long-term implications of such a program?

The educational program described in the study is a systematic and continuing course. Participants are engaged in classroom, small-group, and individual-on-farm instruction. The program is intended to improve technical competence and entrepreneurial skill. Each participant is required to keep accurate production and expense records and to submit his farm business records for summary and analysis at the close of the fiscal year. Guided by directed study of the business analysis, a farm operator makes changes to maximize his economic return insofar as this will contribute to his individual and family goals. The instructional program upon which this study is based meets rigorous criteria of organization and goal orientation and is described as "well-organized."

The criterion variables for the study are operator's labor earnings, return to capital and family labor, and total farm sales. All monetary values are weighted to compensate for factors affecting yearly fluctuation in farm income. These criterion variables are used to calculate the return to individuals and to the community.

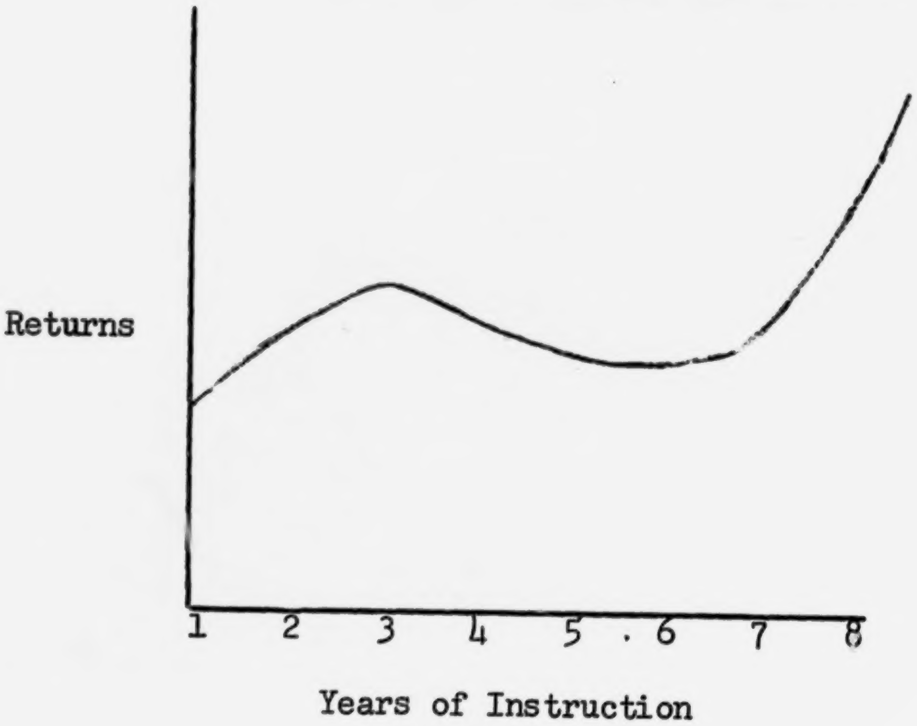
The participants in the study were farmers who were enrolled in farm business management education in vocational agriculture departments of Minnesota public schools for time periods ranging from one to fourteen years. Each of the par-

ticipants was self employed; each was responsible for his own managerial decision making.

The choice of farmers as the recipients of the instructional program had some unusual complexities. It was necessary, for example, to have a complete and accurate system of farm accounts to measure economic gains. It was also necessary to have an instructional program that was highly individualized. There are also some unusual advantages in having farmers involved as the students in the program. Farm income is very responsive to changes in entrepreneurial skill among farm business operators. There are few regulatory forces (industry-wide wage contracts, product-pricing mechanisms, etc.) to establish limits within which a farmer may benefit from his ability to manage his productive resources.

The farmers involved in the study did not, however, constitute the sampling unit. The sampling unit was a completely-analyzed annual farm business record. In this study 3,518 farm records were studied. Of these, 1,475 were from programs judged to be well-organized by meeting the established criteria for organization and good orientation.

Major conclusions from this study are based upon performance curves calculated from farm business and educational input data. These performance curves were calculated by the technique of curvilinear regression. The performance curves represent the relationship of the criterion variables to the instructional program. The general form of the performance curve for the criterion variables is as shown in the following figure:



The shape of the performance curve shows a rising return to educational input during the first three years, a decline during the fourth and fifth years, and a sharply rising slope beginning with the sixth or seventh year of the instructional program. An increase in return during the first three years may result from modern technologies which are rather easily applied to the existing organization of the farm resources. During the fourth and fifth years, the farmer may respond to instruction by reorganizing his business. He revises his combinations of resources, re-examines his productive capacity, and introduces a functional reorganization. The business may be reorganized to accommodate the new levels of efficiency that are available to meet his production goals. The fourth and fifth years, thus, are a period of retooling to maximize the return on available resources. The rise in return beginning with the sixth or seventh year is the response to a more efficient utilization of available resources and a more effective use of entrepreneurial skill.

A specific issue which prompted the inquiry involved the question of whether the decline in returns during the fourth and fifth years was a diminishing marginal return to instruction. Other studies had suggested that the diminishing marginal returns to instruction may begin to occur during the third or fourth years. This possibility raised important questions for school administrators and educational planners. Should a teacher plan only a three-year curriculum and, thus, confine his energies to the period when his instruction shows a rapidly rising return on the investment? When there is an apparent "diminishing marginal returns effect," should the teacher begin with an entirely new group of students so that he will always be engaged with instruction which yields an immediate or an early response?

The "diminishing returns effect," while a practical administrative question, is not subject to precise measurement in this inquiry. For precise analysis, it would be necessary to insure that the increments of educational input are approximately equal over a given time scale. As in most research on educational investment, these increments can only be assumed to be roughly equal throughout the instructional sequence.

The existence of a significant return on an investment in education was a verification of previous inquiries which had been limited to a shorter time span. A major interest in the present study was the determination of the nature of the return over the longer period represented by the performance curves. The results show that although the return is not uniform over the longer time period, returns do accrue to those who are persistent in participation. Moreover, the return for this persistence is great. The decline in return during the fourth and fifth years is more a function of the instructional program than a "diminishing return" effect. Since the business often undergoes major changes, instruction in business reorganization procedures is essential to increased return.

Those who advocate restriction of farm business management education to three or less years will fail to accommodate the increased need for decision making that occurs as part of business reorganization. Failure to provide educational service at this most vital time may deter the farm family from fully utilizing the income production potential that may be derived from careful study and assistance during planning and initiation of resource reorganization.

The educational implications of the study are enormous. First of all, the performance curves, which were calculated to ascertain the nature of response to an educational input and to determine the phenomenon of a diminished return, may not necessarily have any relationship to the economic phenomenon of diminishing returns. The performance curves have the same general form which describes the psychological phenomenon known as the learning curve. This curve is positively accelerating at its beginning, becomes negatively accelerating, and, finally, reaches a plateau and the cycle is repeated. The performance curves, like learning curves, may be manageable. They depend on variables which affect the learning situation. It is the function of education to optimize the conditions which will maximize both the amount of learning and its relevance. If the performance curves in the inquiry are an accurate interpretation of learning curve phenomenon, then this study is among the first to describe such a learning curve over an extended time span and also to calculate the curve as an economic return to an investment in instruction. Further inquiries, accordingly, may contribute to learning theory as well as to a knowledge of the instructional variables which affect the economics of education.

Secondly, in addition to the theoretical implications of the performance curves, there are practical educational conclusions. Although this inquiry has dealt with an educational program for self-employed adults, the instructional program is amenable to the efficiencies of modern educational technology.

Some of the farm records used as basic information for the study were analyzed using a system of electronic data processing (EDP). The calculation of benefit-cost analysis for the educational program is a demonstration of the use of program planning and budgeting (PPB) systems for community instructional programs. As a form of systems analysis, the PPB system has region-wide applicability to educational programs as well as applicability to individual school programs. The instruction provided to farmers in this inquiry was intensive. Since instruction is sequential and programmatic, it is highly amenable to computer-assisted instruction (CAI). Further efficiencies and, thus, more widespread growth of the instructional program used in this study may result from combinations of the various forms of systems analysis. With additional developmental effort, this is likely to be an outcome of this research.

The extent of the return on the educational investment was verified by a benefit-cost analysis. Benefits included those to the community as well as to the individual. Costs included all indirect costs, including opportunity costs, as well as direct costs. The benefit-cost ratio for individual participants over the eight-year period was found to be 4.2:1. For each dollar invested in the program by the individual, increased return to his labor and management was $4.19.

As a further verification of the benefits of such a program, a benefit-cost ratio was calculated for the community. Community benefit was assumed to be the total of the individual benefits. Since there are numerous community benefits to be derived from an increase in cash flow and an increase in the tax base, using only the aggregate increased return to operator's labor and management underestimates the actual community benefit.

The benefit-cost ratio of the program when benefits are measured by increased return to operator's labor and management was about 2:1. When farm sales were used in calculating increased business activity, the benefit-cost ratio increased to about 9:1.

Any investment with a benefit-cost ratio similar to that shown for education in farm business management is a valuable economic asset for a community. As community action groups, boards of education, chambers of commerce, and others seek ways to fight poverty, build affluence in rural communities, and prevent the gradual decay of the rural economic base, farm business management education should be among the high priority alternatives. A strong, dynamic and profitable farm business is the rural community's most valuable asset. This study assists in establishing a rationale for a program of education to increase these assets and, at the same time, describes an educational model for making the decisions which lead to efficiency in program operation and growth.

CHAPTER I

INTRODUCTION AND PROBLEM STATEMENT

Background of the Problem

Although agriculture as an industry has been a superior model to illustrate the value of research, the consequences of technological innovation, and the drama of accelerating output per worker, agriculture in the aggregate is an economic paradox. The industry has made economic advances while individual farmers have not proportionately shared in the increased wealth. Farmers have responded to a combination of incentives by utilizing increased capitalization and production capacity to achieve record industry-wide output even to the point of overproduction. However, production efficiency and overproduction are concepts not necessarily applicable to individual farms. Nor is high output per worker necessarily a measure of efficiency. A most economically inefficient farm may have high output per worker.

There are at least three reasons for agriculture's aggregate growth related to developments in the industry:

a. The introduction of technological innovations (fertilizers, fungicides, herbicides, etc.).

b. The more extensive use of non-human energy.

c. The improvement of cultural practices and management techniques.

Technological innovations have contributed to increased production both in the aggregate and on individual farms. These innovations, available as "packaged" technology, have come largely as a series of practices which have been easy for farmers to adopt. The paradox is clear: technology has helped the agricultural-chemical industry become a rapid-growth industry, but the use of this technology on farms has done little to improve the relative economic position of individual farmers.

The expanded use of non-human energy is the dynamic story of the shift of agriculture to a machine technology. Like other technological innovations, farm mechanization has arrived as "packaged" technology that farmers can adopt easily and quickly. However, major economic rewards for this innovation have gone to the farm machinery industry and, to a much lesser degree, to individual agricultural production units. Farmers have shown willingness to adopt many of the technological innovations, although they have recognized that at the same time an increasing proportion of agriculture's productive inputs must originate off the farm. A paradoxical consequence during the past decade has been that a constant gross income has often yielded a declining net income.

Improvement of cultural practices and management techniques has had relatively little effect on the agricultural industry except in its rather minor role of accelerating the acceptance of the "packaged" technology described above. Much of the innovation affecting production has occurred off the farm. The availability of "packaged" technology has intensified the need for sophisticated management. Despite the shift away from human labor, there has been no widespread shift toward exploiting human skills in management.

Improved management skills in farm production cannot resolve the more complex agricultural problems such as the need for farm youth to migrate, the problem of aggregate overproduction, nor the slow-growth nature of the agricultural industry. Such improvement, however, could make significant contributions to the stability of the entrepreneurial role in agricultural production, a role that should be responsive to an educational input. Responsiveness to education is essential to both economic efficiency and social stability in agriculture.

This study investigated the amount, the direction, and the persistence of this responsiveness at the farm level. The setting of the farm problem was employed to deal with educational questions that are important to agriculture. It also provided the investigators with a model to examine more basic questions concerning the investment role of education, investment criteria applicable to education, and other more generalized aspects of educational management.

A unique attribute of the agricultural sector for the study of the investment effects of education was the availability of sound economic data. Thus, it was possible to establish an accurate estimate of the economic response. Coupled with determinations of input costs, the study offered the empirical evidence necessary to suggest application of theoretical models of the returns to educational investment.

Understanding the organizational, operational, and instructional content of the educational input is a necessary prerequisite to interpretation of the applicability of this study to other sectors of the economy.

Farm management education programs for adults are organized in vocational agriculture departments in Minnesota public secondary schools. The courses in farm management are taught by certified teachers of vocational agriculture. Seventy schools in Minnesota employ one or more full-time adult instructors in agriculture; many others designate responsibility for a limited adult education program in agriculture to the high school vocational agriculture instructor.

The farm management education program usually consists of at least three, and more often four, separate classes for adults. The program has several distinctive characteristics:[1] (1) there are specific enrollees in each course, (2) specific units are taught as a part of each course, (3) the courses are offered in a regular and definite sequence, (4) there is distinct continuity between courses with progression toward farm business reorganization, greater operating efficiency, or other distinctive family goals, and (5) individual on-farm instruction is an integral part of the program plan.

Adult instructors usually consider fifty farm families as a full-time teaching load, although some may enroll as many as sixty-five or more farm families. Each class is developed around a central theme. Those enrolling for the first time study how to keep an accurate and complete farm business record and the relationship of that record to decision making. Farm families in the second year of instruction begin to study the organization and the structure of the farm business and implement those changes which repeated farm business record analyses and careful application of economic principles suggest as most appropriate to meet established farm and family goals. The third and subsequent years of the course are used to gather and study data for decision making and to evaluate outcomes of previous decisions.

Farm families who begin farm business management instruction usually remain enrolled for at least three years and most continue for longer periods. It is not unusual to find farm families who have been continuously enrolled for ten or more years.

A unique feature of the farm management instructional program is that instruction for proficiency in an industry that is highly dependent upon technology and innovation is not based upon new technology but is aimed at management. The curriculum suggested for the farm management program is built around an understanding of basic economic principles and sound decision-making processes. It aims to help farm business operators make the most effective use of technology.

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[1] Palan, Ralph L. "A Program of Instruction for Adult Farmers in Agriculture." M.A. Thesis, Unpublished - University of Minnesota, St. Paul, 1962.

Instruction is offered in three settings: classroom, group, and individualized. While the classroom is the basic setting for teaching principles common to all kinds of farm business, the group session is useful for dealing with problems specific to a limited number of cooperators with special interests or problems. Neither form of instruction could be highly successful, however, without individualized on-farm instruction which permits application of principles and decision making to the unique problems which are a part of every farm business.

Decision making is based upon individual farm record data. It is the summary and interpretation of the farm business record that is used in the decision process. These records served as the basis for evaluating the economic returns to investments in farm business management education. Likewise, the educational inputs of farm business management instruction which occur in measurable units with assigned costs illustrate the public and private investment in an educational system.

Educational Significance of the Study

Early in 1952, the Agricultural Education Department of the University of Minnesota began to study the way in which a farm business record analysis could be used to provide a focal point for the organization of intensive continuing programs in adult education. Smith's[2] framework for analyzing the Minnesota Farm Account Book on a regional basis enabled area vocational technical schools to provide farm business analysis services to surrounding vocational agriculture departments. Early work by Granger examined the income effect of numerous management factors developed as part of the farm record analysis system.[3] He showed the seven management factors to be highly related to income. In dealing with separate analysis regions, he was able to demonstrate that the relationship of these factors to income could be used effectively in management education programs to guide the decision making process. Palan[4] later developed a course of study for farm business management which gave structure and continuity to developing programs throughout the state. Other technical improvements have been made in the record analysis process to systematize the year-end record summary. Most recent was the adaptation of the farm business record analysis system to automatic data processing.[5] Subsequent revisions of the analysis procedure have provided additional data for farm planning and have refined the interpretation of the farm business account.

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[2] Smith, Ralph. "The West Central School and Station as a Regional Center for Analysis of Farm Records in the West Central Area." M.A. Thesis, University of Minnesota, St. Paul, 1955.

[3] Granger, Lauren B. "Some Farm Business Factors Differentiating Earnings of Farmers in the Minnesota Vocational Agriculture Farm Management Program." Ph.D. Thesis, University of Minnesota, St. Paul, 1958.

[4] Palan, Ralph L. "A Program of Instruction for ...."

Attempts to evaluate the Minnesota farm management instruction program began with Cvancara's[6] study of the effects of farm management business analysis instruction on the cash income of participating families. Swanson and Persons[7] studied farmers who had participated in the institutional on-farm training program following World War II under Public Laws 346 and 16. The present study fits into the pattern of on-going evaluation and program revision necessary to ascertain for both educators and taxpayers whether or not the farm management program has provided economic (and social) returns to the farmer and to the community.

This study examined the investment effects of education, a general problem which has been a popular area of inquiry during the past decade in all parts of the world. Most studies have investigated educational investment at the macro-economic level by relating investments in education to growth in gross national product. The micro-economic aspect of the educational input has been sorely neglected. It is significant that this is the first study in occupational education to examine the validity and utility of the basic economic principle of diminishing marginal returns as an educational decision factor. While the present study employs farm management data and deals with farm management problems, its major significance is in the area of educational management.

A further educational importance is related to the choice of investment criteria in education. It was not assumed, for example, that the usual investment criteria were equally appropriate to all types of investments. There has been no empirical evidence of the appropriateness of various investment criteria for educational investments at either the macro or micro level. The criterion which this study used was the cost-output ratio with further refinement to include its dynamic aspects (diminishing return) with successive increments of input. The input consisted of a standardized instructional technique with cost estimates based upon current costs for total program inputs.

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[5] Persons, Edgar. "Farm and Home Business Record Analysis by the Use of Automatic Data Processing Equipment." M.A. Thesis - University of Minnesota, St. Paul, 1965.

[6] Cvancara, Joseph. "Input-Output Relationships Among Selected Intellectual Investments in Agriculture." Ph.D. Thesis - University of Minnesota, St. Paul, 1964.

[7] Swanson, Gordon and Edgar Persons. "Educational Restrictions to Agricultural Success and the Relationship of Education to Income Among Farmers." U. S. Office of Education Project 2604, Washington, D.C., 1966.

The study is unique in that it provides accurate empirical evidence of responses to educational investments. The data bank it provides can be used to test practical applications of theories in economics of education such as those of Becker, Davies, Vaizey, and others. Because of the detailed economic information it includes, the study enables testing of theoretical principles that most studies dealing with national production figures and the United States Office of Education statistics are unable to provide.

The study has further educational significance because it attempts to investigate the effects not only of quantity of education, but also the quality. It compares farmers who participated in programs which were well organized and taught by a full-time adult vocational agriculture instructor with other types of educational situations.

In addition, the study has educational significance as an approach to evaluating an educational procedure for dealing with a portion of a slow-growth industry which may be highly sensitive to an educational input. The evaluation procedure has built-in conditioning features. Each increment of input is evaluated rather than the aggregate educational input. Partitioning the evaluation thus afforded generalizations concerning the reallocation of educational resources as a consequence of the evaluation.

The report by the President's National Advisory Commission on Rural Poverty[8] points to the severe problems of low income that plague many rural areas. Should the results of this study show investments in education in agriculture to yield highly significant returns, a potent weapon will have been found to employ in the war on poverty.

The Problem Delimited

Technology has placed a heavy premium on the application of economic principles to agricultural production and, in general, has required more intellectual investment to accompany the physical capital investment inputs in agricultural production. Thus, there has been in recent years greater emphasis on the need for adult education for farmers. As farm business units continue to grow in business volume and physical size, the need for competent management ability becomes more apparent. The increasing importance of capital management in relation to physical labor involves a new complex of technical skills dependent upon a broader educational base than that which many farm families possess.

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[8] President's National Advisory Commission on Rural Poverty, The People Left Behind, Superintendent of Documents, U. S. Government Printing Office, Washington D.C., 1967.

In spite of the growing interest in the use of record analyses in farm management instruction in the upper midwest, little research has been done to evaluate the effect of the instruction itself on business growth. American educators and the educational system have been under repeated pressure to provide information on the economic efficiency of funds spent for all educational programs.

There is a growing adult education emphasis in the management aspect of farming. Since it is an expanding aspect of agricultural training which local schools provide, and because of rising costs of school instruction, school administrators raise the question: Does it pay? The general question of economic efficiency was the problem this research considered.

Specifically, the research examined data relevant to the following questions:

1. What is the marginal farm business output for each unit of farm business management education input?

2. Are added increments of farm business management education subject to the law of diminishing marginal returns?

3. Do the economic benefits from instruction outweigh the costs?

Because farm business management education requires instruction that is continuous, intensive, and highly individualized, a school presently can enroll only about fifty farm families in the farm business management program for each full-time adult agriculture instructor. Knowledge of the economic efficiency of this type of education in rural areas can help guide fiscal decisions about the allocation of scarce educational resources and has implications for other educational programs for management education for entrepreneurs.

CHAPTER II

REVIEW OF LITERATURE

Economists from Adam Smith's time on have expressed various views concerning the relationship between education and the economy. Alfred Marshall discussed education as a national investment in Principles of Economics and presented a mathematical procedure which allowed the calculation of the returns to education. More recently, researchers have investigated the economic analysis of education.

They have cautiously stated their reasons for looking at the economic issues. Vaizey and Debeauvais wrote:

> "The effectiveness of the use of resources in education raises a fundamental issue. It would clearly be wrong to apply simple tests of productivity to education - to judge it as though it were a brain-producing plant. But there are more effective and less effective ways of using resources; and usually the more effective way is the best way culturally and educationally as well as economically the most efficient."[1]

Miller used an economist's approach:

> "Although the material gains of education have been selected for study, the intent has not been to slur the more subtle satisfactions that come from greater educational attainment. The cultural and social advantages associated with more schooling may well be worth their cost in time, money, and effort even if the economic advantages should cease to exist. The only justification for focusing on the economic advantages is that at present they are the only ones capable of even approximate measurement."[2]

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[1] Vaizey, John and Michael Debeauvais. "Economic Aspects of Educational Development," Education, Economy and Society. Edited by A. H. Halsey, Jean Floud and C. Arnold Anderson, (New York: The Free Press of Glencoe, Inc.), p. 46.

[2] Miller, Herman P. "Annual and Lifetime Income in Relation to Education: 1939-1959," The American Economic Review, L (December, 1960), p. 962.

Educators may challenge Miller's reasoning, but men of his nature have recognized and accepted that in our society dollars and cents statements deliver the message faster than average days in attendance or similar facts.

Macro Economics - Cost Approach

Expenditures for education in the United States are on the increase. Harris found educational expenditures amounted to about $18 billion in the late 1950's and predicted these expenditures would be more than $35 billion in 1969-1970, assuming no inflation took place.[3] He suggested several logical reasons for increased educational expenditures since 1900: (1) doubling of enrollment, (2) increased average daily attendance, (3) increased number of days in the school year, (4) rise of prices, (5) increased capital costs, (6) additional functions undertaken by the school, and (7) the increased proportion of high school students.[4] He also cautioned that "despite the great expansion of demands, education has not held its own in its claims on public revenues since the twenties."[5]

Schultz reported that the annual costs of elementary, high school and higher education in the United States exceed $30 billion.[6] He expressed the need for a concept of costs that would account for all the annual costs of "schooling."[7] His concept "total factor costs" would include costs not borne by the student as well as costs borne by the student and his family. Schultz felt estimates of these two types of costs were not available, and so he attempted to estimate total factor costs directly.

First, he estimated that public school expenditures amounted to $14.4 billion. Second, he estimated that the private education sector accounted for about twelve per cent of all elementary and secondary education and about forty-two per cent of the higher education in the United States. He reasoned that the respective public "annual factor costs" must be utlized to provide costs proportional to the estimated amounts of private education. Third, he considered earnings foregone as a percentage of the total costs of education. He estimated that sixty per cent of the cost of high school was in the form of earnings foregone and that fifty-nine per cent of the cost of college of university education was likewise in foregone earnings. After making the logical mathematical calculations, he totaled these cost estimates to obtain total factor costs.[8]

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[3] Harris, Seymour E. More Resources for Education, (New York: Harper and Brothers, 1960), p. 4.

[4] Ibid. p. 14.

[5] Ibid. p. 44.

[6] Schultz, Theodore W. The Economic Value of Education, (New York and London: Columbia University Press, 1963), p. 5.

[7] Ibid. p. 21.

Vaizey doubted the justification of the consideration of income foregone as an educational cost.[9] He felt that the nature of this cost and similar costs such as those associated with housewives and voluntary workers would change the concept of national income as an estimation of the measurable flows of the economy. He also indicated that it would be necessary to consider an estimate of benefits accruing while being educated if this procedure were utilized.

As Harris and Schultz indicated, many problems exist in the total cost approach to economic analysis. If efficiency is equated with reduced costs, the total cost approach becomes dangerous for it masks many essential and evident cost functions.

Benefit-Cost Analysis

Benefit-cost analysis is by no means a new procedure. Haveman indicated that in 1936 Congress established benefit-cost analysis as a formal part of flood control project authorization.[10] The importance of the benefit-cost procedure in public finance is indirectly indicated by numerous publications of the United States Corps of Engineers and the Bureau of the Budget.

Chinitz and Tiebout defined benefit-cost analysis as simply another way of looking at decisions with respect to marginal changes.[11] They felt benefit-cost analysis was a tool of value in performance budgeting in the public sector, thus providing a measurement framework. They indicated that benefit-cost analysis has been utilized in two ways: (1) to determine the worth of planned projects, and (2) to determine the benefits which have accrued to a project previously initiated.

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[8] Schultz was aware of many problems in estimations of this type and does discuss them in some detail in the original proposal.

[9] Vaizey, John. The Economics of Education, (London, Faber and Faber, 1962), p. 43.

[10] Haveman, Robert H. Water Resource Investment and the Public Interest, (Nashville, Vanderbilt University Press, 1965), p. 22.

[11] Chinitz, Benjamin and Charles M. Tiebout. "The Role of Cost-Benefit Analysis in the Public Sector of Metropolitan Areas," in The Public Economy of Urban Communities, ed. Julius Margolis (Washington, D.C.: Resources for The Future, Inc., distributed by The Johns Hopkins Press, 1965), p. 252.

Davie defined the benefit-cost ratio as the ratio of the present value of future benefits to the present value of future costs.[12] From this definition, the decision rules are obvious: (1) if the benefit-cost ratio for a program is less than one, the program should not be considered (with the exception of a program in which the intangible objectives cannot be adequately weighted in monetary terms), and (2) when comparing alternative programs, the higher ratio is associated with the more desirable program.

Davie reasoned that benefit-cost analysis is particularly applicable in the evaluation of public education expenditure programs due to the time element involved. He felt that the application of this procedure to individual students certainly was appropriate. Individual benefits would be the present value of future additional earnings after taxes.[13] The student would have two types of costs: direct and opportunity. The present value of individual program costs would be the benefit-cost ratio of the program for the student. The program with the highest ratio would be the logical choice provided the student goal was oriented toward economic return.

The benefit-cost formula for the individual participants in a one-year program was:[14]

$$B_j = \frac{\sum_{t=1}^{n} \frac{R_{tj}}{(1+i_j)^t}}{O_j + C_j}$$

n = number of years over which additional income is expected.

R_{tj} = additional income net of taxes in year "t" expected by individual "j" to accrue as a result of completing a program of vocational education.

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[12] Davie, Bruce F. "Using Benefit-Cost Analysis in Planning and Evaluating Vocational Education," a paper prepared for Davis S. Bushnell, Director, Division of Adult and Vocational Research, Bureau of Research, U. S. Office of Education, p. 7.

[13] Ibid. p. 8.

[14] Ibid. p. 16.

i_j = rate of interest used by individual "j" to discount expected future additional income.

O_j = opportunity costs as seen by individual "j".

C_j = direct costs of program to individual "j".[15]

Davie also suggested applying the benefit-cost analysis procedure to programs in vocational education in attempting to evaluate them from a societal point of view.[16] In this case, benefits would be the sum of the present value of future additional income accruing to all students over what their future income would have been had they not taken part in the program. He reasoned that taxes would not be subtracted from the additional returns because society benefits from this additional return.

Davie felt the major problem in "income determination" was determining what part of future gross income is in fact attributable to the training received. He suggested two procedures for isolating the additional income: (1) a simple experimental and control group analysis, and (2) development of a formal model to predict the additional income for a particular program.

Davie suggested that the rate of interest used in discounting benefits and costs in the societal analysis should be lower than that used by individuals. He found a rate of five or six per cent was currently acceptable - higher than government bonds but lower than corporation or individual rates of return.[17]

Davie discussed the cost determinations for the societal analysis in detail. He suggested simply eliminating most direct costs to the student in a society-supported program. He noted that individuals and society often attach different values to opportunity costs. The societal effect of an income foregone by an individual may be canceled due to the transfer of funds to another individual. In contrast, Davie stated:

> "When individuals forego activity which is not income generating in the usual sense, such as housewifery or leisure, some societal estimate of the dollar value of such activity should have to be included in opportunity costs."[18]

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[15] Ibid. p. 15.

[16] Ibid. p. 8.

[17] Ibid. p. 9.

[18] Ibid. p. 9.

If the limited scope of the normal, local program involved is considered, it is apparent that Davie's statement is not in opposition to Vaizey's concern about inclusion of opportunity costs in total cost figures. However, the question of opportunity costs is certainly open to debate.

Considering other societal costs, Davie emphasized that capital costs for additional items such as equipment and building space required by the new program must be considered. He also cautioned that normal operating costs such as salaries, supplies, and utilities must not be neglected. All costs are, of course, discounted to present value before the comparison is made with discounted benefits to determine the societal benefit-cost ratio for a program.

The benefit-cost formula presented for societal evaluation of a one-year program was:[19]

$$\bar{B} = \frac{\sum_{j=1}^{m} \sum_{t=1}^{n} \frac{\bar{R}_{tj}}{(1+\bar{i})^{t}}}{\sum_{j=1}^{m} \bar{O}_{j} + \sum_{j=1}^{n} C_{j} + \bar{C}_{t=0} + a_{\bar{i}p} K}$$

m = the number of program graduates each year.

$\bar{R}_{tj}$ = additional growth income in year "t" expected by society to accrue to individual "j" as a result of completing a program of vocational education.

$\bar{i}$ = rate of interest used by society to discount expected future additional income and costs.

$\bar{O}_j$ = opportunity costs for individual "j" as seen by society.

$\bar{C}_t$ = operating costs of a program in year "t" borne by society.

$a_{\bar{i}p}$ = annuity whose present value is 1, for interest rate $\bar{i}$ and number of years "p".

K = capital cost of a program borne by society.[20]

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[19] Ibid. p. 19.

[20] Ibid. p. 15.

Davie presented an interesting variation of benefit-cost analysis.[21] His proposed variation has the benefits as the unknown in an equation which includes as the known (1) estimated costs of a particular program, (2) the number of students in the program or graduates, and (3) an arbitrarily selected benefit-cost ratio. He suggested that the pertinent question is:

> "What does the amount of benefits in terms of additional future income of students trained in the program have to be...so that the ratio of benefits to costs would at least equal the predetermined level."[22]

The investigator is told to compare the benefit in terms of average annual income to a reasonable estimate of the students' additional annual income as a result of the training.

A set of equations for the alternative method of benefit-cost analysis was presented:[23]

(1)

$$\hat{B} = \frac{X}{\bar{O}_o + C_o + \dfrac{\bar{C}_o + a_{\bar{T}p} K}{m}}$$

$\hat{B}$ = selected cut-off benefit-cost ratio.

X = the present value of future additional income earned by the average program graduate.

o = average value.

(2)

$$Y = \frac{X}{A_{\bar{i}n}}$$

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[21] Ibid. p. 10.

[22] Ibid. p. 10.

[23] Ibid. p. 17.

Y = the average annual amount of additional future income which over "n" years would have a present value of "X".

$A_{\bar{i}n}$ = present value of an annuity for interest rate $\bar{I}$ and number of years "n".

Equation (1) is solved for X, and Y is determined using equation (2). The decision must then be made as to whether or not Y is a reasonable possibility.

Davie concluded his paper with the following list of general limitations to the use of the cost-benefit analysis:

(1) The failure of the procedure to deal with non-monetary returns.

(2) The problem of the comparative value of similar monetary sums for different people.

(3) The failure of the analysis to necessarily identify the best possible program.

(4) No adjustment for where the students will find employment.[24]

In a theoretical discussion of benefit-cost analysis, Hirshleifer, Dehaven and Milliman indicated that certain problems exist in the utilization of the benefit-cost ratio.[25] First, the intangible nature of many costs and benefits often does not permit the calculation of a ratio which is comparable to the unity rule. Second, the ratios of projects are comparable only if the cost elements are similar in scope.

They felt the best criterion was the maximization of the positive differences between the benefits and costs. The formula they recommended discounts the net benefits in a given time period, but yields the same results as the procedure which discounts benefits and costs separately.[26]

They warned that the major problem in the application of the benefit-cost ratio or difference analysis was the tendency to inflate benefits and make ultraconservative estimates of costs.

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[24] Ibid. p. 13.

[25] Hirshleifer, Jack, James C. Dehaven, and Jerome W. Milliman, Water Supply Economics, Technology, and Policy (Chicago: The Rand Corporation, 1960), p. 137.

[26] Ibid. p. 152.

Capital Aspects of Education

Economically developed countries have found it necessary to control economic growth and development, and underdeveloped countries are continually seeking to understand how to generate economic growth. Thus, researchers have sought to explain economic growth in many ways. Although Schultz is often given credit for the present-day capital theory, it was in the testing of conventional explanations for the growth of gross national product that concepts of educational capital become important.

In 1954 Cairncross stated, "...capital accumulation could account for, at most, one-quarter of recorded 'economic progress'" and continued "...there is greater danger that the importance of capital in relation to economic progress will be exaggerated than that it will be underrated."[27]

Schultz indicated that growth in output in agriculture and the rest of the economy could not be satisfactorily explained by an analysis based on conventional inputs. He said:

> "Additional inputs of the kind that are commonly placed in our conceptual boxes - labor, land, other capital and current production items - account for only a part and, as it appears, for a declining part of the increase in agriculture output."[28]

He then presented a theory of two neglected inputs: (1) the raising of the level of the productive arts, and (2) the improvement of the quality of the people as productive agents.

The first widely recognized evidence of the importance of other sources of economic growth came out of work in the National Bureau of Economic Research. Kendrick reported:

> "Between the years 1899 and 1953 total factor productivity in the private domestic economy rose at an average rate of 1.75 per cent. Productivity gains thus accounted for more than half the 3.3 per cent average rate of growth in real product."[29]

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[27] Cairncross, A. K. "The Place of Capital in Economic Progress," International Social Science Bulletin, VI (232 to 236, 1954). Cited in Lee R. Martin, "Research Needed on the Contribution of Human, Social and Community Capital to Economic Growth," Journal of Farm Economics, XLV (February, 1963), p. 75.

[28] Schultz, Theodore W. "Reflections on Agricultural Production, Output and Supply," Journal of Farm Economics, XXXVIII (August, 1956), p. 752.

[29] Kendrick, John W. "Productivity Trends: Capital and Labor," The Review of Economics and Statistics, XXXVIII (August, 1956), p. 251.

Using a different approach, Abramovitz developed an index designed to show how net national product per capital would have grown if the productivity of resources remained constant at base period (1920's) levels while only the supplies of resources per head increased.[30] This index indicated an increase of some 14 per cent due to resource volume increases between the 1870's and the early 1950's. Only 25 per cent of the total increase in net national product is accounted for by the 14 per cent increase due to resource volume.

In his study of economic growth in the United States, Denison reported that the real national income (or product) for the period 1929 to 1957 increased at an average annual rate of 2.93 per cent.[31] He divided this growth rate proportionately among its contributing sources and concluded that education accounted for 0.67 percentage points or 23 per cent of the average annual growth rate.

Denison clearly separated the contributions of education to economic growth into two parts: (1) improvement in the quality of the labour force due to more education, and (2) improvement in productivity due to advances in the "state of the arts" - society's stock of knowledge relevant to production.[32]

Denison emphasized that any procedure to evaluate the relationship of additional education to growth requires information on the amount of additional education actually received by the labor force during the time period involved. He pointed out the great difference between the educational level of the adult population and current students and indicated that this difference has been overlooked in many cases.

In quantifying the effect of increased education, Denison utilized income differentials from the 1950 census data. Of the various methodological procedures and assumptions used in the differential determination, his decision to reduce the income differential to three-fifths the observed differential was most unique. He assumed:

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[30] Abramovitz, Moses. "Resources and Output Trends in the United States Since 1870," The American Economic Review, LXVI (May, 1956), p. 11.

[31] Denison, Edward F. "Measuring the Contribution of Education (and the Residual) to Economic Growth," a paper presented in The Residual Factor and Economic Growth, (Paris: The Organization for Economic Co-operation and Development, 1964), p. 13.

[32] Ibid. p. 22.

> "...three-fifths of the income differentials that appear when men of similar age are classified by years of education result from the effect of more education on the ability to contribute to production; the remaining two-fifths reflect the tendency for individuals of greater natural ability and energy to continue their education, and that of other variables that are associated with, but not the result of, amount of education."[33]

He admittedly did not define explicitly what the two-fifths factor contained nor did he argue very precisely for his assumption. He apparently agreed with common thought concerning the correlation of education and other income increasing factors.

Denison pointed out that the large contribution of education to the growth rate was the result of the combination of two facts: (1) labor represented 73 per cent of the total input of all factors of production, and (2) the large increase in the amount of education.[34] He derived an annual increase in days of education of nearly 2 per cent and felt the quality of labor improved almost 1 per cent annually as a result.

In answer to criticism of his estimate (0.67) of the contribution of additional education to growth as high, Denison presented a few interesting points.[35] First, a better-educated man, on the average, does a better job than a less-educated man. This person will do the same things better, faster, and with less supervision, and he also will do more things than his less-educated cohort. The "great leap" has not been a part of past educational progress. Raising of the educational level of individual occupations has historically occurred slowly and in quantities suited to the occupation. Second, increased amounts of education make persons more receptive to new ideas and more cognizant of better methods of doing things. Third, additional education increases the number of alternatives an individual has relative to a potential occupation and increases his understanding of alternatives. Fourth, the shift in the occupational structure of the labor force has been to occupations requiring higher educational levels for two reasons: (1) availability of better-trained personnel logically led to reorganization of production to take advantage of the personnel, and (2) technological progress has increased the demand in occupational areas which have higher educational demands.

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[33] Ibid. p. 16.

[34] Ibid. p. 36.

[35] Ibid. p. 37.

The theory of human capital developed through education has been argued effectively by Schultz. His reasoning is interesting. First, schooling can contribute satisfactions either in the present or in the future. Second, future benefits are an investment that can affect either future consumption or future earnings. Third, education can be broken into two components - consumption and production. The consumption component manifests itself presently and in the future, but the producer component appears in the future. The consumption component represents values such as "refinement in tastes" and is an enduring component (one not measured in national income reports). The producer component, an investment in skills and knowledge which enhances future earnings, makes educational expenditure, at least in part, an investment in a producer capacity and not a pure consumption.[36] Viewing this investment, Schultz stated:

> "Since education becomes a part of the person receiving it, I shall refer to it as human capital... it is a form of capital if it renders a productive service of value to the economy."[37]

Investigating capital formation trends, Schultz found that investment in human capital has increased.[38] He estimated that the educational capital per member of the labor force rose from $2,236 to $7,555 (1956 dollars) between 1900 and 1957.[39] He also indicated that (1) the annual growth rate of reproducible tangible wealth was about 2 per cent, (2) the annual growth rate of educational capital in the population was 3½ per cent, and (3) the annual growth rate of educational capital in the labor force was slightly over 4 per cent.[40]

Schultz's calculations of growth in national income from schooling involved determining educational investment values and multiplying these values by capital interest rates. This procedure results in an estimate of forty billion dollars growth in national income from schooling investment.[41] Schultz also has estimated the contribution of education of the labor force to economic growth in the United States between 1929 and 1957 at about 21 per cent of the actual increase in national income.[42]

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[36] Schultz, The Economic Value of Education, p. 8.

[37] Schultz, "Capital Formation by Education," The Journal of Political Economy, LXVIII (December, 1960), p. 571.

[38] Schultz, The Economic Value of Education, p. 47.

[39] Ibid. p. 49.

[40] Ibid. p. 51.

[41] Ibid. p. 45.

The interesting results of Schultz's human capital proposal are the estimates of the rates of return on educational investment. He presented three return rates for the United States. Elementary education investments reportedly return 35 per cent, high school investments return 10 per cent, and college level investments return 11 per cent.[43] A weakness in his estimates of returns is his assumption that all the costs of schooling are investment.

Becker's general theoretical analysis of investment in human capital is very informative.[44] He discussed the effects of investment in human capital on earnings and rates of return.

He presented his basic argument relative to earnings using on-the-job training as the investment. He assumed a firm hired employees for a specific time period and that both labor and product markets were perfectly competitive. His equation for the equilibrium condition for maximum profit was:[45]

$$\sum_{t=0}^{n-1} \frac{R_t}{(1+i)^{t+1}} \overset{\perp}{=} \sum_{t=0}^{n-1} \frac{E_t}{(1+i)^{t+1}}$$

where E_t = expenditure during period "t".

R_t = receipts during period "t".

i = market discount rate.

n = number of periods.

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[42] Schultz, Theodore W. "A Critique of U. S. Endeavors to Assist Low Income Countries Improve the Economic Capabilities of Their People," Journal of Farm Economics, XLIII (December, 1961), p. 1071.

[43] Schultz, The Economic Value of Education, p. 62.

[44] Becker, Gary S. Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, (National Bureau of Economic Research, New York: Distributed by Columbia University Press, New York and London, 1964), p. 7.

[45] Ibid. p. 10.

By considering that all training costs take place in the original training period and opportunity costs occur over the entire training period, the equation becomes:[46]

$$MP'_0 + G = W_0 + C$$

What would have been produced in the first time period (MP'_0) plus the excess of future receipts over future outlays (G) equals wages in the first time period (W_0) plus the sum of the opportunity costs and outlays on training (C).

He then defined general training as training that is useful in many firms and presented this equation:[47]

$$W_0 = MP_0 - k$$

The wage of a trainee (W_0) equals the marginal product during his training period (MP_0) minus the cost of his training (k). In other words, the trainee pays for his own general training in a rational business operation.

Becker recognized the mixing of income (MP) and capital (k) accounts in this equation, but felt this was logical because human capital is written off during the training period, not by straight-line depreciation. He illustrated this point by use of typical earnings-age curves for trainees versus untrained.[48] At first the trainee curve was below the "untrained" curve (straight line) due to the costs (depreciation) of training. It accelerated rapidly (concave) to a point above the "untrained" curve before diminishing returns (convex) became apparent.

Specific training was defined as training that has no effect on the productivity of trainees that would be useful in other firms. If only this type of training were given, a rational employee would not accept lower wages in the training period. The firm would pay training costs equal to present value of long term returns (equilibrium). The equilibrium equation is:[49]

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[46] Ibid. p. 12.

[47] Ibid. p. 13.

[48] Ibid. p. 15.

$$MP_o + G\sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t} = W_o + C$$

where C = the cost of training given only in the initial period.

MP_o = opportunity marginal product of trainees.

W_o = wage paid trainees.

W_t = wage in period "t".

MP_t = marginal product in period "t".

Assuming the preceding statements concerning specific training were true, Becker stated that "W" would equal the wage potential elsewhere, $MP_t - W_t$ would be the return in period "t" from training in the original period, and "G" would be the present value of these returns. In other words, "G" equals "C" in full equilibrium.

Martin considered the problem of the differences that may arise between the public and private benefits of investment in human capital.[50] Individual returns may not merit investment in an activity that has great returns for society. Martin argued that this is the reason for the government subsidy, direct and indirect, of certain occupations; for example, medical schools are heavily subsidized. He indicated that the discrepencies between the private and total benefits of education have long been considered the social benefits of education. The difficulty of determining a monetary value for social benefits has been the basis of one argument against the economic analysis of education. He suggested:

> "Laying aside the complications of benefits that cannot easily be imputed to particular individuals, we might measure the approximate economic value of education by searching for instances where quantities and qualities of physical capital available to two labor forces are essentially equiv-

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[49] Ibid. p. 20.

[50] Martin, "Research Needed on the Contribution of Human, Social and Community Capital to Economic Growth," p. 85.

> alent. Productivity differences would appear to be due, at least in large measure, to differences in human capital or to differences in organization, with these differences resulting from human capital differentials."[51]

He attempted to measure the total productivity of human plus social capital by making international comparisons of income (Table 1).

Martin also recognized the problem of allocating among individuals and local, state and central governments the responsibility for making the justifiable human capital investment. He proposed that individuals will logically invest when the value of discounted benefits after taxes exceed present costs. He suggested that the governmental unit should contribute an amount up to the additional tax revenue that would accrue to that particular political unit.

Table 1. INCOME PER CAPITA COMPARISONS FOR NATIONS WITH DIFFERING NATURAL RESOURCES AND EDUCATIONAL DEVELOPMENT

Nation	Natural Resources	Educational Development	1952-1954 Income/Capita
United States	High	High	$1,870
Switzerland	Low	High	1,010
Brazil	High	Low	230
Mexico	High	Low	220

SOURCE: Martin, "Research Needed on the Contribution of Human, Social and Community Capital to Economic Growth," p. 87.

Income Differentials

The influence of higher levels of education on the lifetime earnings of individuals has been studied by many individuals attempting to justify investments in education.

Miller stated that there is some evidence that United States elementary school graduates have had smaller income gains than high school graduates and that the income differential between high school and college graduates has remained fairly constant over time (perhaps increasing in favor of the college graduate).[52] He studied the mean income or earnings of United States males 25 years old and over to determine income differentials. Miller found that high school graduates had 26 per cent and 48 per cent more mean annual income than elementary school graduates in 1946 and 1958, respectively. He also found that college graduates had 57 per cent and 65 per cent ($3,600) more mean annual income than high school graduates for 1939 and 1958, respectively.[53] In 1958 the average elementary school graduate reportedly could expect a lifetime income of about $182,000 as compared with about $258,000 for the average high school graduate. During this same time period, a college graduate could expect to receive about $435,000 lifetime income.

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[51] *Ibid*. p. 86.

Using 1940 census data adjusted for (1) underreporting of professional earnings, (2) underreporting of wages and salaries, and (3) unemployment, Becker presented mean income differentials for 1939.

Table 2. ACTUAL ANNUAL EARNING DIFFERENTIALS BETWEEN URBAN, NATIVE WHITE, MALE, COLLEGE, AND HIGH SCHOOL GRADUATES IN 1939 AT VARIOUS AGES

Age	Per Cent Differential	Absolute Value
23-24	4	$ 51
25-29	29	455
30-34	47	949
35-44	56	1,449
45-54	59	1,684
55-64	53	1,386

SOURCE: Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, p. 71.

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[52] Miller, "Annual and Lifetime Income in Relation to Education: 1939-1959," p. 968.

[53] Ibid. p. 969.

He examined costs for this group and found earnings foregone represented 74 per cent of the total, tuition and fees accounted for 17 per cent, and other direct costs the remaining 9 per cent.[54] Private rates of return were considered and adjusted for mortality, growth and taxation. Becker concluded, "A figure of slightly over 14.5 per cent is probably the best single estimate of the rate."[55]

As an independent estimate of the rate of return to college graduates, Becker used 1950 census data. The differentials between white male college and high school graduates were defined.

Table 3. DIFFERENTIALS BETWEEN WHITE, MALE, COLLEGE AND HIGH SCHOOL GRADUATES IN 1950

Age	Per Cent Differential	Absolute Value
23-24	-16	$ -372
25-29	8	230
30-34	42	1,440
35-44	86	3,419
45-54	100	4,759
55-64	85	4,068

SOURCE: Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, p. 77.

Becker acknowledged the conceptual weaknesses of the technique of estimating the private rate of return on education from income differentials between persons differing in education. The problem is that the true rate of return on education is overestimated because persons differing in education also differ in many characteristics that cause their incomes to differ systematically.

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[54] Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, p. 75.

[55] Ibid. p. 77.

Becker was particularly interested in the "correlation between ability and education."[56] He presented data that he felt suggested that this relationship existed. College graduates were compared to high school graduates. Their average I.Q. was about 13 per cent higher. They had a 50 per cent higher class ranking in high school and twice as many of their fathers were in the "top occupations."[57] Becker was concerned with the bias in rate of return estimates based on the income differential approach. He used five methods to investigate this effect:

1. calculated rates of return after the data were standardized;
2. adjusted rate of return for college based upon high school rank and earnings data;
3. standardization of the rate of return by multiple regression;
4. consideration of the earnings of college drop-outs; and
5. Gorseline's study involving brothers with different amounts of education.[58]

All of these approaches indicated that college itself was the chief contributor to the income differential between high school and college graduates. Becker concluded:

> "...even after adjustment for differential ability, the private rate of return to a typical, white, male, college graduate would be considerable, say, certainly more than 10 per cent."[59]

In discussing investment in college education, Becker compared the private and social (national) gains from college education with those from other investments. He separated typical, white, male, college graduates and typical, white, male, high school graduates with respect to private gain from attending college. This separation led to an interesting conclusion:

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[56] Ibid. p. 79.

[57] Ibid. p. 79.

[58] Ibid. p. 85.

[59] Ibid. p. 88.

> "So while a college education seems to yield a net money gain to the typical white male college graduate, it may not to the typical white male high school graduate."[60]

As an approximation, he measured social returns by before-tax earnings differentials and indirect social costs by before-tax earnings foregone.[61] He fixed the social rate of return at 13 per cent to the 1939 urban, native white, male, college graduates. He used data from E. Denison's Sources of Economic Growth to develop an upper limit (25 per cent) for the social rate of return from college.[62] The private, economic gain thus represented much of the national, economic gain. He warned that a more exact analysis of external effects could change the interpretation entirely.

Renshaw reported the discounted (5 per cent) value of differentials for all males, age 25.5 in 1949 who completed four or more years of college was $20,025.[63] He used median differentials in determining his estimates because (1) census data included medians and (2) marginal value product should be lower than average value product. He criticized Becker for observing the mean census income differentials associated with various levels of education for different age groups during a specified period and then calculating the rate which makes these differentials equal to an estimate of the costs incurred in obtaining an education.[64] He interpreted these as average value products, not marginal value products, and felt these values cannot answer the question, "Should we invest more in education?" He indicated that marginal value product would be lower than average value product at a given point in time due to the operation of the law of diminishing returns. He felt this tends to credit education with any return which should properly be identified with other factors of production which are positively correlated with formal education. His argument is of interest. However, his procedure differs only in the use of medians - an apparently limited compensation for the problems he pointed out.

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[60] Ibid. p. 116.

[61] Ibid. p. 118.

[62] Ibid. p. 120.

[63] Renshaw, Edward F. "Estimating the Returns to Education," The Review of Economics and Statistics, XLII (August, 1960), p. 323.

[64] Ibid. p. 319.

Micro Economics

The study of persons or firms as individual economic units is considered a micro-economic study. It is apparent from the number of previous studies that have dealt with national averages or totals that most people have worked at the macro-economic level. Economic studies dealing with education at the micro-analysis level are few in number. However, there are three micro-economic studies from the field of vocational agriculture education which will be reviewed in detail.

Persons studied the question:

> "What part does the education component of formal education, adult education, and intelligence play in the success of a farm business when the agricultural and economic factors of farm production as well as the socio-biological status of the beginning farmer are also considered?"[65]

He examined the micro-economic input resources of the beginning farm business in sufficient detail to allow the determination of the separate and combined effects of each of the input measures on various measures of farm success. The sample was selected on the basis of four criteria - the subjects (1) had entered the farm business at approximately the same chronological time, (2) were currently farming, (3) had available accurate accounts of agricultural resources for the time of entry, and (4) had available recorded measures of the educational input.[66] The group of men who began farming under the auspices of Public Law 346 and Public Law 16 met the established criteria.[67]

The variables utilized were: highest grade completed, months of on-the-farm agricultural instruction, participation in adult education, a measure of general intelligence (GCT), mechanical aptitude (MAT), age and marital status when started farming, investment in physical capital, ratio of fixed capital to total capital, ratio of net worth to debt, ratio of training costs to total capital investments, size of business (work units and tillable acres) and tenure status. In addition, measures of income were used. These were (1) gross farm income (adjusted for capital gains) as defined by the Internal Revenue Service, (2) net farm income (similarly defined), and (3) gain in net worth per year.[68]

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[65] Persons, Edgar Allen. "The Farmer and His Educational Investment: What Are the Relationships of This Investment to Farm Success?" Ph.D. Dissertation, (University of Minnesota, Minneapolis, 1966), p. 4.

[66] Ibid. p. 18.

[67] Ibid. p. 20.

The predictive value of the individual variables relative to gross income were determined by tests of the partial regression coefficients. The most important variables were age at beginning of training, number of years as farm operator, total beginning capital, size of business - tillable acres, ratio of fixed to total capital and the number of adult classes attended. A smaller sub-sample showed MAT scores and the ratio of beginning net worth to total beginning liability to be significantly related to gross income.[69]

Age had a negative relationship to gross income. Persons hypothesized that the younger one starts farming, the greater his success. However, he warned that the relationship may have been the result of the age characteristics of the particular sample group.

The significance of the relationship of the number of adult classes attended to gross income was of great interest. The economic factors were also found to be highly intercorrelated. Values of R^2 indicated the predictor variables were accounting for approximately 30 per cent of the total variation in gross income.[70] A problem pointed out as a contributing factor to the unexplained variation in gross income was the fact that gross income was represented only for one year of a cyclic continuum. Important income factors such as inventory change were ignored in the analysis.

The predictive value of the individual variables relative to yearly gain in net worth were also evaluated. The significant variables were age at beginning of training, attendance at adult classes, total beginning capital and size of business in tillable acres. The R^2 for all the variables was approximately .20.[71]

Persons concluded that the three classifications of variables, educational, biographical and economic, were all important in predicting farm success. Since the educational variables were of particular interest, these variables (GCT score, highest grade completed, months of institutional on-farm training and the number of adult evening classes attended) were subjected to an analysis of multiple covariance. Gross income, net income and yearly gain in net worth were used as criterion measures.

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[68] Ibid. p. 23.

[69] Ibid. p. 59.

[70] Ibid. p. 63.

[71] Ibid. p. 73.

The general level of intelligence (GCT) showed no significant relationship to the criterion measures. The particular sub-sample involved did not include a wide range of scores. The bi-modal distribution of scores with modes at grade 8 and grade 12 had a mean grade level below that expected for the general farm population.[72]

Contrary to the regression analysis, the highest school grade completed was reported to be significantly related to yearly gain in net worth.[73] Persons suggested that years of schooling may be substituted for some of the economic prerequisites for farm success; however, the exact relationship was not evident from the data.

The months of institutional on-farm training did not show significant relationships to the criterion measures. Persons pointed out possible reasons for this situation: (1) high attendance requirements, (2) possible diminishing returns, and (3) successful farmers may have been eliminated early due to the labor earnings limitation ($2,400) for training payments.[74]

The number of adult classes attended was found significantly related to gross income. It was thus apparent that continuing education did have an impact on general farm productivity as measured in gross income. This study did not, however, attempt to apply any of the theoretical models of returns to educational investment to the data. Thus, the question of the rate of return to investments in education for this sample of farm operators still remains.

Cvancara studied the direction or degree to which production units in agriculture responded to educational investment.[75] The major objective was to determine whether or not instruction in farm management, a part of the vocational agricultural education program, affected various farm measures including farm income.

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[72] Ibid. p. 82.

[73] Ibid. p. 86.

[74] Ibid. p. 87.

[75] Cvancara, Joseph George. "Input-Output Relationships Among Selected Intellectual Investments in Agriculture," Ph.D. Dissertation, (University of Minnesota, Minneapolis, 1964), p. 6.

The study involved two groups of Minnesota farmers. Group A consisted of farmers enrolled in a farm management analysis program during the years 1960, 1961, and 1962. Group B consisted of farmers who had received farm management instruction during 1962. A farm in group A was paired with a farm in group B on the basis of information for 1962. Pairing was based upon farm size (measured in work units), the combination of livestock and crop enterprises, and soil, climate and topographical factors. Thirty-three farm pairs were obtained. Data for the years 1960 and 1961 for group B were obtained by personal interview while data was present on farm business analysis forms for group A.

The variables selected for study were years of farm management instruction, operator's age, years operated a farm, years of general education, size of business in man work units, dollars of farm sales, total acres farmed, tillable acres, and cash income (total farm sales minus total cash operating expenses).[76] Using the analysis of variance procedure to test the homogeneity of the means of the two groups on the different variables, he rejected the hypothesis ($\mu_1 = \mu_2$) for the following:

(1) There is no difference in farm sales between groups A and B for the years 1960, 1961, and 1962.

(2) There is no difference between groups A and B for the years 1960, 1961, and 1962 when the criterion measure is difference between farm sales and farm operator expenses.

Cvancara stated:

> "Group A...had greater farm sales during this period and comparable farm expenses in 1960 and 1961 than group B. This may be interpreted as follows: instruction in farm management is responsible for greater efficiency and better management for farmers in group A."[77]

The correlation coefficients were determined for each of the predictive variables and cash income for the three years studied. The coefficient of multiple determination (R^2) reportedly accounted for 63 per cent of the variance in cash income in 1960, 72 per cent in 1961 and 64 per cent in 1962.[78]

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[76] Ibid. p. 42.

[77] Ibid. p. 59.

[78] Ibid. p. 51.

Partial correlation procedures were used to eliminate five of the independent variables which were not accounting for a significant portion of the variance in cash income. The independent variables, farm management instruction, work units, and farm sales, were retained for predicting cash income for the years 1960, 1961, and 1962.[79]

Table 4. THE GROUP MEANS FOR FARM SALES AND CASH INCOME FOR THE 33 PAIRS OF FARMERS IN THE TWO GROUPS

	Farm Sales		Cash Income	
Year	Group A	Group B	Group A	Group B
1960	$16,491.97	$14,580.58	$7,248.58	$5,028.00
1961	18,039.73	16,005.00	8,428.09	5,430.73
1962	20,946.76	18,553.00	9,355.45	7,060.33

SOURCE: Cvancara, Joseph George. "Input-Output Relationships Among Selected Intellectual Investments in Agriculture," Ph.D. Dissertation, (University of Minnesota, Minneap-Olis, 1964), p. 41.

A weakness which must be recognized is that cash income for a given farm is not a good measure of earnings and is likely to fluctuate considerably from year to year.

Cvancara also examined the output relationships.[80] The input costs for farm management instruction in the various school districts were determined by the following general procedure:

> (Per cent of time spent on the farm management phase of adult instruction x cost of instructors per day) + travel + other direct costs ÷ farm unit enrollment = farm unit cost for instruction.

The average input costs computed per farm unit for the 33 pair farms were $114.84 in 1960 (group A), $102.27 in 1961 (group A), $89.55 in 1962 (group A), and $95.94 in 1962 (group B).

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[79] Ibid. p. 56.

[80] Ibid. p. 61.

The output values of farm management instruction were evaluated by comparing yearly increases in income for group A versus group B. Group A had an increase in cash income of $1,179 (1960 vs. 1961) and group B had an increase of $403 with a difference of $776 in cash income (per farm unit). Extension of the procedure to the 1961 versus 1962 comparison showed group A increasing $927 and group B increasing $1,629 per farm unit. Cvancara concluded:

> "This seems to indicate three things: (1) group B farms had the potential of increasing farm income, (2) improvement in farm income is subject to the diminishing return effect from year to year with the greatest increase occurring during the second year of this experimental three year period. A continuous though somewhat smaller average increase persists during the third year."

The input costs were then considered. They were subtracted from the average per farm unit dollar increase between 1960 and 1961 of $776. Group A farmers increased their income $558 over group B farmers ($776-218). A general extrapolation was made taking 50 farm units times $588.89 yielding $27,944.50 as the increase in cash income due to farm management instruction by one full-time vocational agriculture instructor.[81]

The procedure followed by Cvancara does not account for all costs of participation in an adult education program as do the more sophisticated theoretical models of benefit-cost analysis. The data show that the response to educational investment is positive, however, and provides some general measure of the magnitude of returns that may be expected from participation in education.

Rolloff developed and tested a model for determining the influence of the farm business analysis phase of instruction in farm management upon factors of economic efficiency and management and the understanding of economic principles.[82]

He selected variables to measure the educational output components.[83] Economic understanding was measured by use of McCormick's instrument.[84] Economic efficiency variables were selected on the basis of two criteria: (1) the variables were regularly used as a measure of farm management efficiency, and (2) the variables were judged significant by experts.[85] The selected variables were gross income, net cash income, net farm income, net worth, net margin, operating ratio, overhead ratio, gross income per $1,000 invested, net farm income per $1,000 invested, gross income per man equivalent, and productive man work units per man equivalent.

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[81] Ibid. p. 79.

[82] Rolloff, John A. "The Development of a Model Design to Assess Instruction in Terms of Economic Returns and the Understanding of Economic Principles," Ph.D. Dissertation, Ohio State University, Columbus, 1966, p. 4.

[83] Ibid. p. 41.

Measurements of changes in economic efficiency from year to year were made utilizing the first year farm record as the base. This procedure assumes that the first year of instruction does not contribute to the managerial efficiency.[86] Benefits that may accrue during the first year as a result of technical assistance are ignored since they are not unique to the farm management education program. Measures of earnings for the second year were adjusted by a correction factor based upon data from the Economic Research Service of the United States Department of Agriculture. These correction factors consisted of indexes computed from base year average state prices divided by the second year average state prices within various cash income categories. Cash expenses were adjusted in total.

Rolloff proposed to select program input variables on the basis of three criteria: the inputs were regularly computed by teachers of vocational agriculture for state reports, the inputs were judged as potent variables by experts, and the inputs logically could be assigned a standardized monetary value per unit.[87]

The local vocational agriculture instructors were asked to report the contact hours (class time, farm management consultation at the school and on-farm instruction time).[88] Rolloff then used the following procedure:

> "...the total class hours attended divided by the total offered. The resulting percentage is then multiplied by the mean hours of instruction offered

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[84] McCormick, Floyd G. "Developing a Procedure for Evaluating Farmer Understanding of Basic Profit Maximizing Principles," Ph.D. Dissertation, Ohio State University, Columbus, Ohio, 1964, p. 43.

[85] Rolloff, "The Development of a Model Design to...." p. 43.

[86] Ibid. p. 52.

[87] Ibid. p. 47.

[88] Ibid. p. 53.

> for the program group. On-farm instructional hours are then added giving the total number of contact hours of instruction received per farm operator. The latter figure is then multiplied by the stipulated assessment arrived at by the investigator, this providing the total assessed cost per program participant."[89]

This assessment procedure is subject to question. The reason for percentage adjustments for class attendance is not clearly explained. The difference between total class hours offered and mean hours of instruction offered is questionable. The procedure indicates that the farmer was only charged for the classes that he attended. As a result, the cost of the class time of the instructor was valued in proportion to attendance because doubling attendance doubled the assessment. The farmer who regularly attended classes must at some point begin subsidizing the farmer with poor attendance habits if the total input costs for class instruction were realistic and finite.

The assessment value utilized was $5 per unit instructional hour based on state reimbursement rates for vocational education in Ohio.[90]

In the final analysis, Rolloff presented data indicating that a positive mean dollar ratio of 1 to 53.16 existed for the group between the 1965 input costs of instruction and change in net farm income between 1964 and 1965.[91]

The mean dollar input cost of the program was $83 and the mean dollar output as net farm income was $4,722.[92] Net farm income included cash receipts plus or minus changes in inventory values, capital gains or losses minus cash expenses minus depreciation.

The input cost assessment procedure must be evaluated critically. It apparently is designed to consider a large share of the educational inputs as fixed societal costs. The cost figure utilized would appear to be comparable to teacher salaries per hour and to exclude other operating and capital costs. The value of opportunity costs for the individuals and society are also ignored. The major problem in the procedure may be the utilization of actual contact time as the basis of final cost determination. The gain made by charging for man-contact hours of class time does not compensate for the instructor's non-contact time and other program costs.

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[89] _Ibid_. p. 59.

[90] _Ibid_. p. 68.

[91] _Ibid_. p. 89.

[92] _Ibid_. p. 90.

The model Rolloff presented is, however, a step forward in the analysis of individual economic returns from instruction in farm management. The limitations of his cost calculations, however, greatly reduce the significance of the final results in individual or community decision-making processes.

The three studies discussed do not exhaust the micro-economic studies in the field of education. The studies are unique because the educational program studied, adult farm management, provides realistic data concerning economic benefits in relation to educational inputs. Persons' study did not handle the monetary question directly. Cvancara utilized a matched-pair design to determine farm management instruction returns and Rolloff utilized a first-year record versus a second-year record design to determine instructional effect.

These studies, however, provided stimulus for critical thought concerning the isolation and treatment of educational costs and benefits. These studies were mainly concerned with individual benefits resulting from participation in adult education programs. Only part of the societal and individual costs were considered as variable costs which function in the decision process. The logic is correct. Variable costs are utilized by the individual in the selection of alternatives. The problem is that not all variable and fixed costs are identified. As a result, individual benefits are optimistic (Rolloff) and societal (community) benefits derived from extrapolations involving individual returns are of questionable value. It should be pointed out that these studies were concerned with the monetary benefits of the instructional input to particular groups. The critical reader may point out additional considerations such as spill-over effects and intangible benefits to which no reference has been made in the studies reviewed.

Conclusion

Studies dealing with the total costs of education have clearly indicated that the costs of education are great and that there are logical reasons to expect them to increase in the future.

The applicability of benefit-cost analysis in the evaluation of educational programs has been effectively argued. Since it functions at the marginal level, it has considerable economic merit. As procedures for evaluating intangible benefits become more refined, the precision and efficiency of benefit-cost analysis will increase.

The investment properties of education are obvious. The analytical techniques for the isolation of the quantities of investment are complex as Becker indicated. The macro-economic aspects of educational or human capital demand attention in national planning. Although nebulously defined, the return from human capital is very significant.

Income differentials between cohort groups have provided the base for many arguments for additional education. Differentials, however, must be utilized in view of the limitations inherent in their calculation.

Differentiation of macro-economic studies and micro-economic studies presents no problem in verbal explanation. In actuality, the separation is at times less clear. The area of micro-economics should be given major emphasis. Individual and community returns to educational programs are less limited by assumptions and, thus, more useful in this setting.

The major problem in the economic analysis of education is the separation of the tangible and intangible benefits. Thus, assumptions are demanded in any economic analysis of education. The philosophical and theoretical aspects of these assumptions certainly merit continuing attention and study. The results of the economic analysis of education can be of value to the field of education if these results are utilized in view of the original assumption.

CHAPTER III

DESIGN OF THE STUDY

Introduction

Evaluation of the effects of investment in education on agriculture required that farm economic success be carefully and accurately measured. A population was needed that had two primary attributes. (1) measurable educational input and (2) sound measures of agricultural success.

Cooperators in the farm management education program of vocational agriculture departments in public schools in Minnesota meet these rigorous criteria. Farm families enroll in regular courses of farm business management education for several consecutive years. The course content is designed to aid in the decision-making processes of farm management. Instruction in farm management is usually based upon a complete record of the farm business which is kept in The Minnesota Farm Account Book, or a similar record book, and summarized at the close of the fiscal year. It is the farm record summary or business analysis, as it is frequently called, which is the basis for making decisions.

Because the quality of instruction in farm management was altered in recent years by the development of curricular aids, researchers arbitrarily decided that the farm record years from 1959 through 1965 would provide a basis for determining the effects of investment in adult education for farmers in systematic programs of farm management instruction.

Enrollment in farm management education programs remained relatively static in the developmental years of the farm management approach to adult education in agriculture. Table 5 shows the number of farm record books that were analyzed in each of the seven area analysis centers since 1956. The total number of records analyzed remained relatively constant until the early 1960's when it began to increase more rapidly.

Selecting the Sample

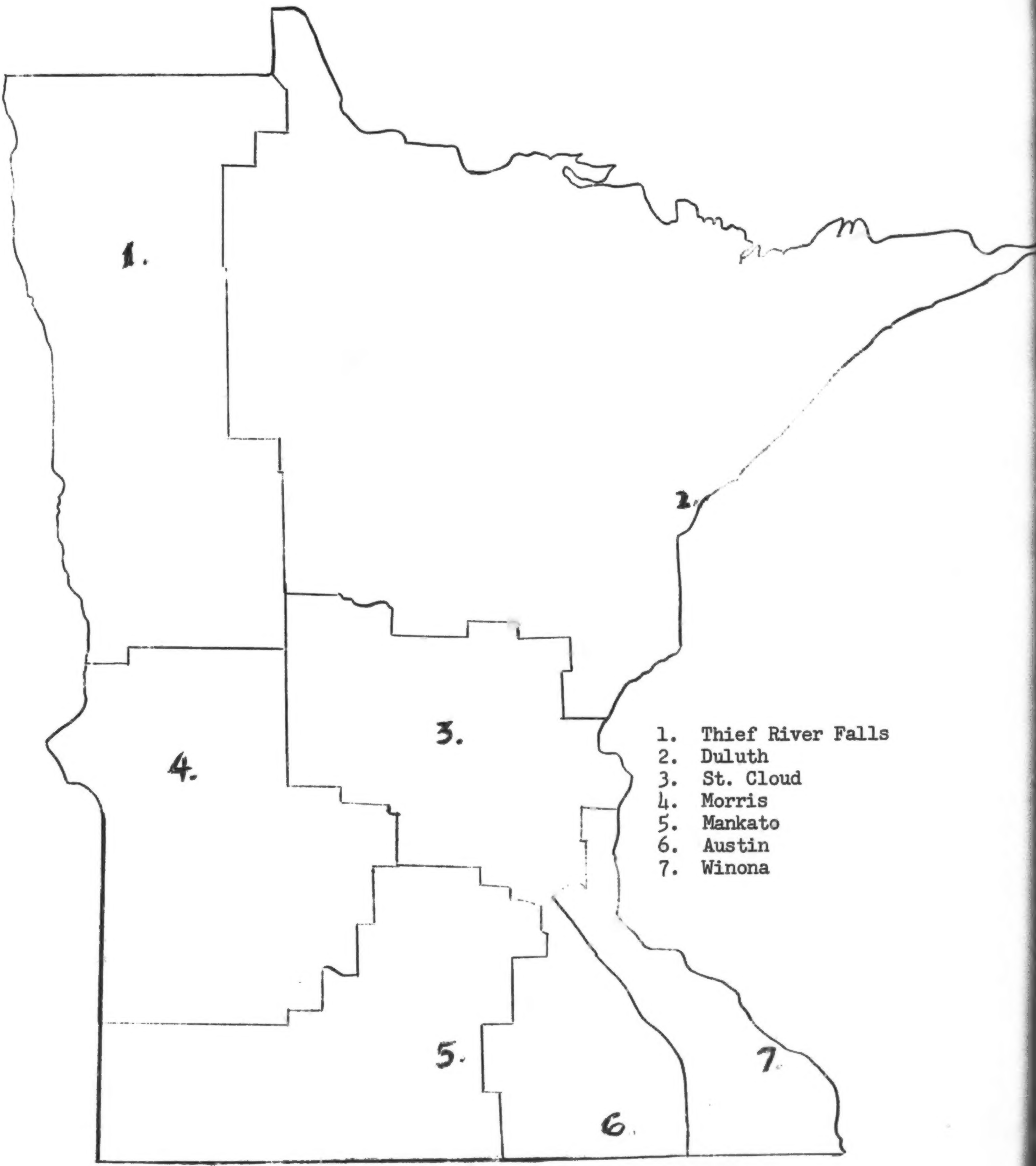
The population for this study consisted of farmers who had farm business records analyzed for the fiscal years 1959 through 1965 through the vocational agriculture farm business management education program. The population was finite and could easily be described by counting the number of records recorded in each area analysis center for the prescribed period.

The authors had two choices: (1) select a representative sample from each record analysis area by a random process or (2) utilize the entire finite population and, thus, eliminate sampling bias. The authors chose the latter method and elected to use all records that had been analyzed in the seven area analysis centers for the fiscal years 1959 through 1965. A slight deviation in the plan was adopted in the St. Cloud analysis area. Due to different administrative procedures, only the farm record summaries from those enrolled in the St. Cloud Public School farm management program were available in the area analysis center file. Those records and the record summaries from the Foley School constituted the sample from the St. Cloud area analysis center.

Table 5. NUMBER OF FARM RECORDS SUMMARIZED IN EACH AREA ANALYSIS CENTER - 1956-1966

Year	Duluth	TRF	Mankato	Morris	St. Cloud	Austin	Winona	Yearly Total
1956	28	60	76	39	--	39	23	265
1957	82	54	64	25	57	39	36	357
1958	101	52	58	32	50	46	43	382
1959	79	55	77	16	70	50	31	378
1960	21	57	54	38	77	70	27	344
1961	47	54	52	35	80	81	26	375
1962	45	85	64	43	70	102	41	450
1963	70	138	66	54	102	170	60	660
1964	60	151	99	45	137	202	90	784
1965	123	202	122	73	195	223	114	1,052
1966	156	289	197	54	240	230	121	1,287
Sums	812	1,197	929	454	1,078	1,252	612	6,334

All records from the other six centers were utilized in the study with the exception of about fifteen that were either too incomplete to be useful or represented some highly divergent form of farm operation.



1. Thief River Falls
2. Duluth
3. St. Cloud
4. Morris
5. Mankato
6. Austin
7. Winona

Figure 1. VOCATIONAL AGRICULTURE FARM MANAGEMENT AREAS

The total sample consisted of 3,518 farm records collected from the seven area analysis centers for the fiscal years 1959-1965.

Location of Analysis Centers

Figure 1 illustrates the location of the analysis centers and the areas that they cover. School submitting records for analysis in 1965 were relatively wide and evenly spread except for some sparseness in the northeastern part of the state and comparatively high concentration in the south central and southeastern regions. The school submitting records were not more numerous near the analysis centers and were distributed throughout the state in about the same proportion as the farm population.

Collecting the Data

Data were gathered from three sources: (1) the files of each area analysis center, (2) the State Department of Education, Agricultural Education Section, and (3) from local teachers of vocational agriculture.

The prime data source was the files of the area analysis center. The research team inspected each farm record summary on file in the area analysis center and transferred the necessary information to a data sheet. Some information not pertinent to this study was also collected because of its potential value in further research. A sample data sheet is presented as Appendix A.

It was noted that some information was not consistently recorded in the farm record summaries. The missing information usually pertained to liabilities and non-farm assets and thus prevented computation of net worth or changes in net worth from year to year.

Personal information such as age and the year started farming were also frequently missing. This information was later obtained for the majority of the sample by questionnaires sent to teachers of the farm management program. The same questionnaire was utilized to obtain information on the amount of formal schooling attained by each farm operator and his wife as well as the months the operator participated in the institutional on-farm training program.

Records from the Agricultural Education Section of the Minnesota State Department of Education were examined for the years 1961-1965 to determine the number of adult classes each farm operator attended as well as to determine the number of on-farm instructional visits he received from the vocational agriculture instructor. This information was not available on all farmer cooperators included in the study.

Information from the questionnaire sent to vocational agriculture instructors and from the files of the State Department of Education was recorded on the information sheet used in collecting data from the area analysis center. All data were subsequently recorded on cards suitable for electronic data processing.

Analysis of Data

Data from the 3,518 farm record analyses, the State Department of Education, and teacher questionnaires are presented both as descriptive information and as a basis for inference.

Descriptive Analysis

Only the common statistical presentations such as frequency distributions, arithmetic means, unbiased standard deviations, Pearson's product moment correlations, and chi squares are used to describe the characteristics of the sample and its various sub-sample components. The formulae used to compute the statistics can be found in most elementary statistical reference books but are presented here for the readers' information without detailed explanation of the rationale underlying each statistic.

The arithmetic mean is the summation of the numerical value of all individual items in a set divided by the number of items in the set. It is represented by this formula:

$$\bar{X} = \frac{\Sigma X}{N}$$

Throughout this report, the term "average" will refer to the arithmetic mean.

The unbiased standard deviation reported for each descriptive item has been computed using the formula:

$$SD = \sqrt{\frac{\Sigma (X-\bar{X})^2}{N-1}}$$

Pearson's product moment correlations, computed for each possible combination of two variables in this study, were accomplished by a procedure equivalent to the following formula:

$$r = \frac{\Sigma (\bar{X}-X)(\bar{Y}-Y)}{SD_x \; SD_y}$$

or as expressed in computational form:

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N\Sigma X^2 - (\Sigma X)^2] - [N\Sigma Y^2 - (\Sigma Y)^2]}}$$

Pearson's correlation coefficient (r) indicates the strength of the relationship between two variables. The closer the value is to the maximum of ± 1.00, the stronger the relationship between the variables is considered to be. To test if the relationship between two variables is significantly different than zero, the correlation values in this study have been referred to a table of "r" values reproduced by Snedecor.[1] The table provides the critical values needed to be considered significantly different from zero for both the .5 and .01 levels of significance.

Chi-square tests determined whether or not cross tabulated data were related. First, it was necessary to calculate the cell frequencies which would be expected to occur if the two cross tabulated variables were not related, i.e., if they were independent. Then the expected cell frequencies were compared with the corresponding, observed cell frequencies. The chi-square formula for independence was:

$$X_2 = \sum_{j} \sum_{K} \frac{(f_o jK - f_e jK)^2}{f_e jK}$$

In a chi-square problem, the number of expected or hypothetical frequencies that were free to vary constituted the degrees of freedom. The rule used for degrees of freedom was: degrees of freedom are equal to one less than the number of rows times one less than the number of columns. A table of chi-square values was consulted to see if the chi-square value with its degrees of freedom was statistically significant.

Inference

The purpose of this study was not only to describe the sample of farmers who had participated in adult education programs in farm management but also to make some inference about the probable response to education to those who had not yet enrolled, or who had been enrolled only recently.

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[1] Snedecor, George W. Statistical Methods, Iowa State College Press, Ames, Iowa, 1946, p. 149.

Two regression techniques were selected to help describe the response to educational inputs: (1) bivariate curvilinear regression and (2) multiple regression. The first technique, bivariate curvilinear regression, was most useful in studying the relationship between the educational inputs (years of farm management instruction) and three separate and distinct measures of farm financial success.

Curvilinear regression is represented by the model:[2]

$$Y = \alpha + \beta_1 X^1 + \beta_2 X^2 + \beta_3 X^3 + \ldots \beta_K X^K + \epsilon$$

In the sample, this formula is:

$$\hat{y} = a + b_1 X^1 + b_2 X^2 + b_3 X^3 + \ldots b_K X^K$$

The object of this technique was to reduce the sum of squares of the observations about the regression line to a minimum and maximize the power of the function to predict the dependent variable from information provided by the independent variable. The technique provided for the computation of successively higher order regression equations until computation of the next highest order equation did not result in a significant reduction in the sums of squares of observations about the regression line.

To test if the regression equation was accounting for a significant portion of the sums of squares, the hypothesis $H_o \sim B_1, B_2 \ldots B_k = o$ was examined. The statistic utilized to test this hypothesis was:

$$F = \frac{\dfrac{R_K^2}{K}}{\dfrac{1-R_K^2}{N-(K+1)}} \qquad F \overset{d}{=} F[K, N-(K+1)]df$$

The F value obtained was checked against the F values listed in an appropriate statistical table[3] for a predetermined level of significance. In this study, the 5 per cent level of significance was utilized.

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[2] Steel and Torie. Principles and Procedures of Statistics, McGraw Hill, 1960, p. 283.

[3] Hays, William L. Statistics for Psychologists, Chicago: Holt, Rinehart, and Winston, 1963, pp. 677-679.

To test if the k^th degree equation added significantly to the reduction in sums of squares about the regression line as compared to the k-1 degree equation, the hypothesis $H_o \sim B_k = o$ was tested with the statistic:

$$F = \frac{\dfrac{R_K^2 - R_{K-1}^2}{1}}{\dfrac{1 - R_K^2}{N-(K+1)}} \qquad F \overset{d}{=} F[1, N-(K+1)]df$$

Degrees of Freedom

The regression equation of the highest degree was selected where both the null hypothesis $H_o \sim B_1, B_2, B_3 \ldots B_k = o$ and the hypothesis $H_o \sim B_k = o$ were rejected.

The regression line represented by the appropriate equation was charted to permit visual interpretation of the relationship between the two variables studied.

The strength of the relationship of the two variables was assessed by examining the coefficient of determination based upon the multiple correlation coefficient, R. The coefficient of determination, R^2, "is the proportion of the total sum of squares that is attributable to another source of variation, the independent variable."[4]

Often, more than one independent variable has a significant influence on the variation in the dependent variable. To test the significance of these variables and to define the absolute relationship to the dependent variable, the multiple regression technique was employed. The population model for this statistic is:[5]

$$Y = \alpha + B_1 X_1 + B_2 X_2 + B_3 X_3 \ldots + B_K X_K + \epsilon$$

The sample statistical model is:

$$\hat{Y} = a + b_1 X_1 + b_2 X_2 + b_3 X_3 \ldots + b_K X_K$$

The value of b_k was calculated by using simultaneous equations. Data from the sample were employed to define the relationship that existed in the sample set. A separate equation was solved for each b value. Electronic computers (IBM 360, CDC 1604, and CDC 6600) solved the problems of computation of many simultaneous equations used in this study.

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[4] Ibid. p. 187.

[5] Ibid. p. 283.

A test of the significance of the contribution of each independent variable to the total regression equation was made by use of the t statistic described by Steel and Torie.[6]

$$\frac{t = b'y1\cdot 2}{S_{b'}}$$

df (degrees of freedom appropriate for multiple regression)

The ratio of the standard partial regression coefficient to the standard error of that coefficient was examined for each independent variable. Those variables that were not making a significant contribution to the regression equation were eliminated.

As in the curvilinear regression equation, the coefficient of determination, R^2, was used to assess the strength of the relationship of the variables.

The Index System of Measuring Farm Income

This study used farm record information from a period of seven consecutive years, 1959-1965. There were many important factors that may have influenced the income of farmers during that period of time. It was necessary to devise a method that would compensate for the following economic and natural phenomenon:

a. Natural growth in the size and volume of farm businesses not subject to educational inputs.

   Failure to compensate for this growth would credit education with increased business volume when in fact it would have occurred without the influence of the educational input.

b. Changes in the general economy of the country.

   Although farm incomes do not vary in direct ratio to the general economy, they are responsive to general economic change. Failure to adjust for economic change would credit education with gains or losses made by farm businesses as a result of agriculture's response to national trends.

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[6] Ibid. p. 289.

c. Price cycles and farm price levels.

Agriculture has been characterized by periods of unusually high or low prices for some farm commodities as an industry response to periods of marked change in productive output. To examine the response of agriculture to education without compensating for the effects of price cycle and farm price level would not present a true picture of the relationship.

d. Uncontrolled forces of nature.

The natural phenomenon of weather has a marked effect upon the financial success of the farm business. During the brief period of the study, agriculture throughout the state was adversely affected by unusual or severe weather. Unseasonal frost severely damaged a major portion of the maturing corn, soybean, and other late fall crops throughout the state in one year included in the study. Other natural phenomena such as flood and drought played a major role in determining farm income in two other years of the study.

The factors which characterize agriculture represent only a portion of the elements which influence the economic return to the farm operator. They, along with the educational inputs being studied, were considered to be among the most influential factors affecting farm income. The index system was devised to minimize the effects of their special focus and to allow examination of the response of farm income to education.

The average financial success of farmers analyzing farm records for the first time in a particular year was arbitrarily assigned an index value of 100. Within the same record year, the average success of farmers who were analyzing records for the second, third, or subsequent years were assigned an index value relative to the performance of the group analyzing records for the first time. An illustration of how this technique was utilized is presented in Table 6 for the labor earnings reported in records analyzed in 1965.

This example (Table 6) shows that the labor earnings for those analyzing records for the second year have an index value of 135 compared to the index value of 100 for those analyzing records for the first year.

In periods of adverse prices, weather, or the business cycle, there may have been low earnings in the initial analysis year. The 1962 analysis year is presented as an example (Table 7).

Table 6. MEANS AND INDICES OF FARM RECORDS ANALYZED IN 1965

	Years Analyzed				
	1	2	3	4	5
Mean Labor Earnings	$4,026	$5,429	$6,501	$5,326	$6,170
Labor Earnings Index	100	135	161	132	153

Table 7. MEANS AND INDICES OF FARM RECORDS ANALYZED IN 1962

	Years Analyzed				
	1	2	3	4	5
Mean Labor Earnings	$2,903	$3,234	$3,768	$3,769	$3,009
Labor Earnings Index	100	111	130	130	104

An increase in labor earnings of only $865 for farmers in the third analysis year results in an index of 130 while in 1965 it required an increase of $1,200 to produce a similar index. Thus, the index system of examining the success of the farm business for a particular year is an accurate assessment of the financial success of farmers with different farm record histories relative to those with no effective farm management instruction. The effects of some of the factors which cause wide variation in income from year to year have been dampened in the computation of an index.

The relationship of educational inputs to farm success is reported in this study both in absolute financial returns and as reflected by computation of an index of farm success.

CHAPTER IV

DESCRIPTIVE DATA

Introduction

Agricultural census data provided a basis for comparing the study population with farm operators in general.

The census and sample populations were grouped according to census definition of economic class.[1] Table 8 indicates the economic class of farms which the 1959 agricultural census for Minnesota used to categorize commercial farms.

Table 8. 1959 AGRICULTURAL CENSUS ECONOMIC CLASSES OF FARMS AND THE NUMBER OF FARMS IN EACH CLASS

Class of Farm	Value of Farm Products Sold	Number of Farms
I	$40,000 and over	2,330
II	20,000 to 39,999	7,503
III	10,000 to 19,999	28,428
IV	5,000 to 9,999	44,546
V	2,500 to 4,999	28,223

Because the study included very few farms in economic class V, the discussion which follows refers only to economic classes I, II, III, and IV.

Operator Age

The historical growth pattern followed in establishing a farm production unit suggested that a relationship should have existed between the age of the farm operator and the economic class to which he belonged. The ratio of older farmers to younger farmers should have been higher in economic classes I and II than it was in economic classes III and IV if this assumption was correct and if the profit motive predominated in all age classifications.

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[1] U. S. Bureau of the Census. U. S. Census of Agriculture, 1959, Volume I, Counties, Part 15, Minnesota, p. XXIV. U. S. Government Printing Office, Washington, D.C., 1961.

Table 9 shows a statistically significant relationship between farm operator age and economic class of farms in 1959.

Table 9. THE RELATIONSHIP BETWEEN FARM OPERATOR AGE AND ECONOMIC CLASS OF FARMS - 1959 CENSUS DATA

Age	Economic Class I	Economic Class II	Economic Class III	Economic Class IV	Sum
25	23 (45)[a]	142 (148)	516 (563)	955 (880)	1,636
25-34	378 (400)	1,508 (1,314)	5,743 (4,987)	6,869 (7,797)	14,498
35-44	814 (656)	2,462 (2,152)	8,952 (8,171)	11,525 (12,774)	23,753
45-54	611 (640)	1,980 (2,098)	7,473 (7,966)	13,095 (12,455)	23,159
55-64	312 (427)	1,048 (1,401)	4,741 (5,320)	9,365 (8,318)	15,466
65+	135 (105)	317 (344)	887 (1,305)	2,455 (2,040)	3,794
Sum	2,273	7,457	28,312	44,264	82,306
Ave. Age[b]	45.1	43.8	44.1	46.5	45.4

[a] Numbers in parentheses are the expected values used in the chi-square calculation: Chi Square - 1,171 ($p. < .001$).

[b] The average age was calculated using frequencies times midpoints of age categories.

The significant chi square did not indicate which observations were different from the frequency expected in each cell. By comparing observed and expected frequencies in the cells of the table, it was possible to describe the relationship of the variables. While the pattern is not consistent, generally there were fewer farmers under 34 years of age in economic class I than would have been expected if there were no relationship. It was hypothesized that it took several years to build up a farm business to a volume sufficient to place a farm operation in the upper economic class. The fact that more older farmers than expected fell in economic class IV, however, suggested that the assumption of a constant profit motive for all age classes was not valid. Except for economic class I, average operator age generally declined in the upper economic classes.

The higher age of class IV farmers than was suggested by the hypothesis of a positive age-economic class relationship was explained by examining the two extreme age categories.

Both age categories in economic class IV had observed frequencies in excess of the expected values. Two suggested reasons for this phenomena were advanced by the assumptions that (1) very young farm operators lacked sufficient capital to develop a business volume great enough to permit farm sales categorized by a higher economic class and (2) farmers approaching retirement may not have always had maximum profit as a goal and, thus, may not have strived to increase business volume above that categorized by low economic class.

The 1964 farm census for Minnesota showed an age-economic class relationship with some similarity to that reported for 1959. Although the numbers were somewhat different, it was possible to make the same general comments about the farm operators in the top four economic classes as were made in reference to 1959 data.

The average age of farmers in each economic class was greater in 1964 than in 1959 with the exception of economic class I. This fact gave general support to the claim of an aging farm population. A marked increase in the number of operators under 44 years of age in economic classes I and II also pointed out the advancement of younger men to the more affluent economic classes.

Table 10 shows a significant relationship between age and economic class. A slight reversal of the 1959 relationship was evident since the highest economic class showed a greater proportion of young farm operators than expected while the lowest class had more older operators than expected. There was no consistent pattern in the average age of the operators within an economic class as observed from high to low economic groups. The deviation of observed from expected values was most consistent and pronounced in the two extreme economic classes.

Table 10. THE RELATIONSHIP BETWEEN FARM OPERATOR AGE AND ECONOMIC CLASS OF FARMS - 1964 CENSUS DATA

Age	Economic Class				Sum
	I	II	III	IV	
25	41 (71)[a]	183 (235)	702 (649)	729 (700)	1,655
25-34	558 (517)	2,103 (1,711)	5,317 (4,721)	4,063 (5,092)	12,041
35-44	1,168 (931)	3,839 (3,083)	9,140 (8,505)	7,544 (9,172)	21,691
45-54	1,074 (1,027)	3,261 (3,401)	9,377 (9,385)	10,224 (10,121)	23,936
55-64	472 (716)	1,694 (2,371)	5,744 (6,542)	8,776 (7,056)	16,686
65+	125 (176)	304 (582)	1,130 (1,606)	2,536 (1,732)	4,095
Sum	3,428	11,384	31,410	33,872	80,104
Ave. Age[b]	44.7	44.0	45.2	48.4	46.3

[a] Numbers in parentheses are the expected values used in the chi-square calculation: Chi Square - 2,453 (p.$<$.001).

[b] The average ages were calculated using frequencies times midpoints of age categories.

By combining parts of the 1959 and 1964 census data, the relationship between year and economic class for each of the six farm operator age categories was examined. A chi-square test for independence was made within each of the age categories.

According to Table 11, more of the younger farmers in 1964 were in the upper economic classes than expected. Correspondingly, more of the older farm operators were in the lower economic classes.

Table 11. THE RELATIONSHIP BETWEEN FARM OPERATOR AGE AND ECONOMIC CLASS OF FARMS - 1959 AND 1964 CENSUS DATA

Age	Year	Economic Class I	II	III	IV	Sum	Chi Square
25	1959	23	142	156	955	1,636	69[b]
		(32)[a]	(162)	(605)	(837)		
	1964	41	183	702	729	1,655	
		(32)	(163)	(612)	(847)		
	Sum	64	325	1,218	1,684	3,291	
25-34	1959	378	1,508	5,743	6,869	14,498	647[b]
		(511)	(1,973)	(6,042)	5,972		
	1964	558	2,103	5,317	4,063	12,041	
		(425)	(1,638)	(5,018)	4,960		
	Sum	936	3,611	11,060	10,932	26,539	
35-44	1959	814	2,462	8,952	11,525	23,753	1,106[b]
		(1,036)	(3,293)	(9,456)	(9,967)		
	1964	1,168	3,839	9,140	7,544	21,691	
		(946)	(3,008)	(8,636)	(9,102)		
	Sum	1,982	6,301	18,092	19,069	45,444	
45-54	1959	611	1,980	7,473	13,095	23,159	996[b]
		(829)	(2,577)	(8,286)	(11,467)		
	1964	1,074	3,261	9,377	10,224	23,936	
		(856)	(2,664)	(8,564)	(11,852)		
	Sum	1,685	5,241	16,850	23,319	47,095	
55-64	1959	312	1,048	4,741	9,365	15,466	266[b]
		(377)	(1,319)	(5,044)	(8,726)		
	1964	472	1,694	5,744	8,776	16,686	
		(407)	(1,423)	(5,441)	(9,415)		
	Sum	784	2,742	10,485	18,141	32,152	
65+	1959	135	317	887	2,455	3,794	19.7[b]
		(125)	(299)	(970)	(2,400)	(3,804)	
	1964	125	304	1,130	2,536	4,095	
		(135)	(322)	(1,047)	(2,591)	(4,204)	
	Sum	260	621	2,017	4,991	7,889	

[a] Numbers in parentheses are the expected values for each year and economic class.

[b] Significant beyond the .001 level.

Education

A discussion of the educational attainment of the Minnesota farm-operator population may serve as a basis for examining the relationship between education and income in the entire production agriculture sector. Because the 1959 agricultural census did not include an accounting of the educational level of farm operators, only the 1964 data is reported.

Table 12. THE RELATIONSHIP BETWEEN YEARS OF EDUCATION (FARM OPERATORS) AND ECONOMIC CLASS OF FARMS - 1964 CENSUS DATA

Years of Education	Economic Class				Sum
	I	II	III	IV	
0-4	23	48	220	473	764
	(32)[a]	(110)	(294)	(328)	
5-7	120	544	1,806	3,047	5,517
	(232)	(794)	(2,124)	(2,367)	
8	1,051	4,229	13,942	18,009	37,231
	(1,567)	(5,355)	(14,334)	(15,975)	
9-11	398	1,556	3,764	4,112	9,830
	(414)	(1,414)	(3,784)	(4,218)	
12	1,317	4,127	9,632	7,697	22,773
	(958)	(3,276)	(8,767)	(9,772)	
13-15	320	836	1,295	938	3,389
	(143)	(487)	(1,305)	(1,454)	
16+	171	282	447	393	1,293
	(54)	(186)	(498)	(555)	
Sum	3,400	11,622	31,106	34,669	80,797
Ave. Age[b]	10.5	10.2	9.7	9.1	9.6

[a] Numbers in parentheses are the expected values for each year and economic class: Chi Square - 3,076 ($p. < .001$).

[b] Frequency in each cell times midpoint of the educational category was used to determine average age. (Midpoints used were: 3, 6, 8, 10, 12, 14, and 16, respectively, for each "Years of Education" category.)

If a positive relationship existed between education and economic class, farmers with more education would be in higher economic classes. The observed frequency of people with higher levels of education would exceed the frequency expected in the high economic class. Likewise, the frequency of people with low educational levels would exceed the expected frequencies in the lower economic classes.

Table 12 shows the chi-square value to be very large and highly significant. The frequency matrix suggested a positive relationship between education and economic class. Farmers with more years of education tended to be in the higher economic classes. Educational attainment was bimodal with grades 8 and 12 accounting for 46 per cent and 28 per cent, respectively, of the total farm operators.

The average educational attainment of farm operators in economic class IV was more than one high school grade below operators in economic class I. Educational attainment decreased as economic level decreased suggesting again that a positive relationship between education and economic level exists.

It is a generally accepted fact that the level of educational attainment has increased steadily in the past two decades. A negative relationship between the age of farm operators and educational attainment was expected. Census data did not report this information by economic class but provided information on the total farm operator population. Table 13 shows the relationship between operators' age and educational level for all farm operators in Minnesota in 1964.

As expected, the relationship is highly significant. Of the operators over 65 years of age, about 30 per cent had less than eight years of formal schooling. Of farm operators under 35 years of age, less than 3 per cent had not exceeded this educational level. It was significant, however, that such a wide variation does not exist between older and younger farmers when post-high school education is considered. While 3.7 per cent of the 65-plus age group had some college or post-high school training, of farmers in the under-35 age bracket, only 9 per cent had attended college or post-high school training programs.

The average educational attainment decreased approximately one grade for each increase in age category. The increase was due to greater numbers attaining grade 12 rather than large increases in post-high school attendance. Compulsory school attendance laws assisted in increasing the educational attainment of the younger farm operators.

The Relationship Between the Population of Minnesota Farm Operators and the Sample of Farm Operators in this Study

If the results of the study were to have meaning in inference to the general population of Minnesota farm operators, it was necessary to compare the study sample with all farmers in

Table 13. THE RELATIONSHIP BETWEEN FARM OPERATORS' AGES AND EDUCATION - 1964 CENSUS DATA

Years of	Age					
Education	35	35-44	45-54	55-65	65+	Sum
0-4	17 (364)[a]	113 (579)	366 (695)	717 (557)	1,262 (280)	2,475
5-7	392 (1,815)	1,346 (2,887)	3,214 (3,464)	4,104 (2,776)	3,285 (1,398)	12,341
8	3,644 (9,089)	12,401 (14,456)	20,288 (17,346)	17,637 (13,898)	7,820 (7,000)	61,790
9-11	2,486 (2,342)	4,510 (3,724)	4,511 (4,469)	3,043 (3,581)	1,269 (1,804)	15,919
12	10,904 (4,656)	10,346 (7,406)	6,842 (8,886)	2,892 (7,120)	669 (3,586)	31,653
13-15	1,246 (695)	1,319 (1,106)	1,025 (1,327)	785 (1,063)	352 (536)	4,727
16+	504 (332)	652 (528)	575 (634)	324 (508)	203 (256)	2,258
Sum	19,293	30,687	36,821	29,502	14,860	131,163
Ave. Age[b]	11.08	9.96	9.06	8.45	7.74	9.28

[a] Numbers in parentheses are the expected values for each cell: Chi Square - 30,856.

[b] Frequency in each cell times midpoint of the educational category was used to determine average age. (Midpoints used were: 3, 6, 8, 10, 12, 14, and 16, respectively, for each "Years of Education" category.)

the state to determine their similarities. The agricultural census of 1959 and 1964 divided commercial farms into several categories based on the farm sales (Table 8). The total farm sales in this study include three economic items not included in farm sales as defined in the agricultural census. Agricultural conservation, diverted acre payments, and gasoline tax refunds are not included in the census computation of farm sales. The differences between the sales definitions, however, are not great enough to prohibit some comparisons.

Table 14 shows that the distribution of the two groups according to economic classes was quite different for the population of all Minnesota farm operators and the sample in the study. Such difference may in part, however, have been a reflection of the farm management program. In both 1959 and 1964, much larger proportions of farm management participants were in economic classes I, II, and III than were farm operators in the general population. There was also a larger proportion of the farmers of both groups in these economic classes in 1964 than in 1959.

Table 14. PROPORTIONS OF THE FARM POPULATION IN ECONOMIC CLASSES I THROUGH IV AND OTHERS - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA

		Economic Class				Less Than
		I	II	III	IV	$5,000
Census	1959	1.6%	5.2%	19.5%	30.6%	25.8%
	1964	2.6%	8.7%	23.9%	25.8%	22.6%
Study	1959	6.1%	17.8%	42.0%	26.8%	7.3%
	1964	10.1%	34.6%	37.4%	15.5%	2.3%
First Record	1964	10.4%	31.5%	38.3%	15.8%	4.1%

Because the farm management program was not directed at low income farm families, it was logical to consider the proportions of farm operators in each economic class after excluding all farms with sales totaling less than $5,000.

Table 15 reports the comparison of the four top economic classes in 1959 and 1964. While the sample of farmers in this study still had larger proportions in the upper economic classes, the disparity was not as great. In fact, proportions in economic classes I and III were quite similar. The 1964 first-year participant distribution is very much like the distribution for all records even though it shows less than one third the size of the entire group.

Table 16 shows some relationship between age and economic class. Thus, consideration of average ages in each economic class was especially important in making comparisons between census and study data. Several hypotheses were developed to

Table 15. PROPORTIONS OF THE FARM POPULATION IN ECONOMIC CLASSES I THROUGH IV - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA

		Economic Class			
		I	II	III	IV
Census	1959	2.8%	9.1%	34.3%	53.8%
	1964	4.3%	14.2%	39.2%	42.3%
Study	1959	6.5%	19.2%	45.4%	28.9%
	1964	10.3%	35.5%	38.3%	15.9%
First Record	1964	10.7%	32.9%	39.9%	16.4%

explain the younger average ages in the study sample compared to the population. (1) The participants in the farm management instruction programs may have been more profit oriented because they were younger and needed to support families. (2) They may have had more exposure to education and, therefore, were more eager to enroll in an educational program. (3) Younger farmers may have been more willing to accept instruction and advice from an adult vocational agriculture instructor.

Table 16 points out the younger average age of first-year participants in 1964 as compared to the average age of all participants. While the average age of farm operators in census data economic classes I and IV is greater than in classes II and III, this same trend does not appear in the study section of the table. A general relationship between age and economic class is shown most clearly by the 1964 participant averages with increasing average ages in the upper economic classes. As farm operators enroll in the management instruction program for longer periods of time (thus, average increases), their total sales increase. If the census data showed the same general trend, one might argue that, in general, farmers' total sales increase with age. However, the census data does not substantiate this assumption. This fact is important to remember as the correspondence between farm management instruction and income is considered.

Table 17 shows that average sales increased in each economic class in the census population from 1959 to 1964 while

Table 16. AVERAGE AGE OF FARM OPERATORS IN ECONOMIC CLASSES I THROUGH IV - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA

		Economic Class			
		I	II	III	IV
Census	1959	45.1	43.8	44.1	46.5
	1964	44.7	44.0	45.2	48.4
Study	1959	38.7	39.4	39.2	37.4
	1964	39.6	39.2	38.7	36.6
First Record	1964	35.9	36.6	34.6	34.2

averages either dropped or showed smaller relative increases in the study averages. It could be hypothesized that with increasing confidence and experience on the part of instructors, participation in the farm business management education program spread to less prominent farmers in the community.

Table 17. AVERAGE FARM SALES IN ECONOMIC CLASSES I THROUGH IV - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA

		Economic Class			
		I	II	III	IV
Census	1959	$54,553	$24,417	$13,232	$7,144
	1964	79,295	26,604	13,943	7,346
Study	1959	66,924	27,078	14,062	7,652
	1964	66,389	27,085	14,910	7,957
First Record	1964	60,351	27,072	14,742	7,977

Since farm operators in the study had greater average farm sales and tended to be more numerous in the higher economic classes, average size of farm was expected to likewise be greater for farmers in the study. However, as Table 18 shows, the average farm in the population economic classes I and II is much larger than the average farm in the study both in 1959 and 1964. Apparently, farmer participants did not add many acres to their farms with added years of participation since the average farm size for first-year records approximately equals the overall averages for all participants.

Table 18. AVERAGE SIZE OF FARM IN ECONOMIC CLASSES I THROUGH IV - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA

		Economic Class			
		I	II	III	IV
Census	1959	1478.4	643.8	377.9	256.5
	1964	623.9	402.1	291.0	226.9
Study	1959	371.3	335.0	268.6	261.8
	1964	565.0	374.6	320.6	284.7
First Record	1964	480.8	378.8	319.9	258.3

Average farm operators in this study had more years of education within each economic class than the population census average. As Table 19 shows, operators' years of education increased from class I to class IV in the census group. The economic class I category for first-year record farmers in 1964 averaged more than twelve years of formal education. It was hypothesized that the higher general education level of study participants in comparison to census data was a function of their age.

The most logical conclusion is that farmers enrolled in management education programs are different from the average Minnesota.farmer either in initial entry characteristics or characteristics that result from organized instruction. It is not the purpose of the study to suggest whether or not the farm management education program has identified the proper segment of the farm population as clientele.

Table 19. AVERAGE YEARS OF EDUCATION OF FARM OPERATORS IN ECONOMIC CLASSES I THROUGH IV - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA

		Economic Class			
		I	II	III	IV
Census	1964	10.5	10.2	9.7	9.1
Study	1964	11.9	11.3	11.1	11.1
	1959	11.0	11.3	11.3	10.9
First Record	1964	12.2	11.4	11.0	11.5

Table 20 shows the analysis center area averages and the corresponding county data for several pertinent variables. In general, the county analysis area comparisons show the same trends as comparisons between the state average and study average. Farmers in the management program have more volume of sales, are younger, better educated, and more likely to be in the upper economic classes according to volume of sales.

Table 20. COMPARISON BETWEEN SELECTED FACTORS REPORTED BY AREA ANALYSIS CENTERS AND COUNTY CENSUS DATA - 1959 AND 1964 AGRICULTURAL CENSUS AND STUDY DATA[a]

Area		Factor		
		Average Operator Age	Average Farm Sales	Acres Total Land
Mankato	1959	35.4	$20,965	232
	1964	36.0	31,219	315
	1964[b]	34.4	33,705	351
(County)	1964	47.6	17,250	224
Thief River Falls	1959	37.2	12,278	448
	1964	39.6	19,052	578
	1964[b]	37.1	19,465	517
(County)	1964	49.7	11,451	430
Morris	1959	34.7	29,850	303
	1964	38.7	22,069	328
	1964[b]	31.0	17,033	312
(County)	1964	48.0	13,099	299
St. Cloud	1959	34.3	13,129	238
	1964	36.3	16,105	280
	1964[b]	32.4	14,176	287
(County)	1964	50.3	10,538	197
Duluth	1959	42.2	9,190	263
	1964	42.8	10,336	364
	1964[b]	39.4	9,596	493
(County)	1964	51.2	5,832	257
Austin	1959	39.4	25,026	237
	1964	38.2	27,251	270
	1964[b]	34.4	17,699	254
(County)	1964	48.7	12,552	210
Winona	1959	42.8	15,573	265
	1964	41.5	23,845	341
	1964[b]	39.9	24,166	348
(County)	1964	48.9	12,078	236

[a] Not all counties reported.

[b] The averages of the first farm business records submitted.

CHAPTER V

FINDINGS OF THE STUDY

Three variables were chosen as criteria in this study: (1) total farm sales, (2) labor earnings, and (3) return to capital and family labor.[1] Each measure was selected because it reported a different aspect of income. Labor earnings is the return to operator labor and management (not including the family labor). Return to capital and family labor is a better measure of the total return to the farm business than any other common economic measure. Total farm sales is a fairly reliable measure of total business volume.

Multiple Regression Analysis

By referring to an intercorrelation matrix involving all the variables in the study, eleven variables were selected which were significantly correlated with labor earnings at or beyond the .05 level. There were some other variables highly correlated with labor earnings which were judged not to be logical or useful predictors. Several of the independent variables suggested in the proposal for this study had such small correlations with labor earnings that they were not included in the regression analysis. In this category are: years of formal education of farm operator and his wife, age of farm operator, and number of years farmed. Variables for which limited observations were available were also eliminated from the regression analysis.

Total Farm Sales

All independent variables except work units on crops provided significant regression coefficients in predicting total farm sales. The three variables with the largest "t" values in Table 21 are total farm capital, work units, and livestock units per 100 acres. Contrary to expectations, three highly significant regression coefficients have negative weights: (1) index of crop yields, (2) work units per worker, and (3) work units on livestock. The other significant regression weights are record number, income from work off the farm, and total tillable land.

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[1] Labor earnings equals total farm receipts including changes in inventory and family living from the farm less total farm expenses including a charge for capital and unpaid family labor.

Table 21. TOTAL FARM SALES - MULTIPLE REGRESSION ANALYSIS

Variable	Mean	Standard Deviation	Regress. Coef.	Beta t Value a/
Record Number	3.08	2.37	513.722	3.53**
Total Farm Capital	47,042.38	36,196.00	.267	23.04**
Income - Work Off Farm	365.28	846.78	.734	1.77*
Index of Crop Yields	100.64	35.37	-77.450	-7.48**
Livestock Units/100 A.	316.14	294.06	21.450	14.13**
Work Units	479.86	306.43	39.237	20.03**
Work Units/Worker	322.79	115.62	-14.843	-3.60**
Work Units - Crops	138.54	97.36	-8.731	-1.41
Work Units - Livestock	322.22	178.86	-26.209	-7.95**
Factors Above Average	3.36	1.64	897.842	3.30**
Total Tillable Land	250.89	197.73	4.953	1.77*
Total Farm Sales	21,200.48	27,087.34		

Multiple Correlation (R): .70

Coefficient of Determination: .49

Standard Error of Estimate: 19505.97

Regression Intercept Point: -826.240

SOURCE: Based upon operators' share of total farm sales from business analysis reporting capital assets.

a/ Significance level, two-tailed test: * $\leq$ .10, ** $\leq$ .01.

There are two ways of determining the accuracy of the regression analysis and, thus, indicating the degree of confidence in the prediction equation. First, the multiple correlation coefficient of .70 shows that the eleven independent variables together serve as good predictors of total farm sales (zero indicating no prediction and 1.00 indicating a perfect relationship). The proportion of variation in the dependent variable, total farm sales, accounted for by the eleven independent variables was shown by the square of the correlation coefficient. Table 21 shows a coefficient of determination (R^2) of .49.

Another method of evaluating the prediction accuracy of the regression equation is shown by an analysis of variance. Table 22 reports a very large, highly significant F value.

Table 22. TOTAL FARM SALES - ANALYSIS OF VARIANCE FOR REGRESSION

Variation Source	Degrees of Freedom	Sum of Squares	Mean Squares	F[a] Value
Attributable to Regression	11	116.2464×10^{10}	10.56785×10^{10}	278**
Deviation from Regression	3268	124.3419×10^{10}	3.804831×10^{8}	
Total	3279	240.5883×10^{10}		

[a] Significance level, two-tailed test: ** $\leq$ .01.

To arrive at the predicted sales for an individual farm, each regression coefficient is multiplied by the appropriate farm business measure. By adding these computed weights to the intercept value, an estimate of the total farm sales can be made.

Labor Earnings

The two variables with the most significant regression weights in predicting labor earnings are "factors above average" and "total farm capital." Three variables do not provide significant regression weights: "livestock units per 100 acres," "work units on crops," and "work units on livestock." There are two regression coefficients with signs contrary to expectations; both "livestock units per 100 acres" and "work units on livestock" have negative weights. The "t" values are relatively uniform in size compared to the "t" values computed in the total farm sales equation.

Table 23 reports a multiple correlation coefficient of .45. By squaring that coefficient, it was determined that the regression equation accounted for approximately 20 per cent of the variability in labor earnings. It also lists the regression coefficients and intercept point for prediction of labor earnings.

Table 23. LABOR EARNINGS - MULTIPLE REGRESSION ANALYSIS

Variable	Mean	Standard Deviation	Regression Coefficient	Beta t Value[a]
Record Number	3.08	2.37	120.923	3.86**
Total Farm Capital	47,042.38	36,196.00	.025	9.86**
Work Off Farm Income	365.28	846.78	.350	3.93**
Index of Crop Yields[b]	100.64	35.37	16.207	7.28**
Lvstk. Units/100 A.	316.14	294.06	-.207	-.63
Work Units	479.86	306.43	1.198	2.84**
Work Units/Worker	322.79	115.62	1.765	1.99*
Work Units on Crops	138.54	97.36	1.725	1.29
Work Units on Lvstk.	322.22	178.86	-.841	-1.19
Factors Above Average	3.36	1.64	596.205	10.19**
Total Tillable Land	250.89	197.73	1.106	1.84*
Labor Earnings	3,705.31			

Multiple Correlation: .45

Coefficient of Determination: .20

Standard Error of Estimate: 4194.05

Regression Intercept Point: -2911.23

SOURCE: Based upon operators' labor earnings for farm business analyses reporting capital assets, 1959-1965.

[a] Significance level, two-tailed test: * ≦ .10, ** ≦ .01.

[b] St. Cloud index is based on county averages.

The analysis of variance table (Table 24) shows an F value of 77. The probability of an F value of that magnitude occurring by chance was less than 1 in 100.

Table 24. LABOR EARNINGS - ANALYSIS OF VARIANCE FOR REGRESSION

Variation Source	Degrees of Freedom	Sum of Squares	Mean Squares	F[a] Value
Attributable to Regression	11	148.4739×10^8	13.49763×10^8	77**
Deviation from Regression	3268	574.8450×10^8	$.1759011 \times 10^8$	
Total	3279	723.3189×10^8		

[a] Significance level, two-tailed test: ** ≦ .01.

Return to Capital and Family Labor

"Total farm capital," "index of crop yields," and "factors above average" are highly significant predictors of return to capital and family labor. Other significant predictors, according to the computed "t" values recorded in Table 25, are "record number," "income from work off the farm," "livestock units per 100 acres," "work units on crops," and "work units on livestock." Contrary to expectations, "livestock units per 100 acres" had a negative Beta weight.

The proportion of variation which the regression accounted for was approximately 32 per cent. The F value of 146 reported in Table 26 confirmed that a significant proportion of the variation was due to the regression equation.

Summary

The independent variable "record number" was an important predictor for each of the measures of farm earnings. Also important is the failure of measures of gross business size (total tillable land, work units on crops, work units on livestock, and total work units) to contribute consistently to the prediction of measures of farm earnings. The significant relationship of "farm capital" and "factors above average" to measures of earnings reinforces the assumptions of the importance of capital and the controllable factors of management to economic success.

Table 25. RETURN TO CAPITAL AND FAMILY LABOR - MULTIPLE REGRESSION ANALYSIS

Variable	Mean	Standard Deviation	Regression Coefficient	Beta t Value a/
Record Number	3.08	2.37	122.546	3.88**
Total Farm Capital	47,042.38	36,196.00	.052	20.80**
Work Off Farm Income	365.28	846.78	.413	4.59**
Index of Crop Yields	100.64	35.37	21.379	9.51**
Lvstk. Units/100 A.	316.14	294.06	-.712	-2.16*
Work Units	479.86	306.43	.185	.44
Work Units/Worker	322.79	115.62	-.217	-.24
Work Units on Crops	138.54	97.36	2.485	1.84*
Work Units on Lvstk.	322.22	178.86	2.946	4.12**
Factors Above Average	3.36	1.64	523.207	8.86**
Total Tillable Land	250.89	197.73	.674	1.11
Return to Capital	5,518.03	5,161.73		

Multiple Correlation: .57

Coefficient of Determination: .32

Standard Error of Estimate: 4234.30

Regression Intercept Point: -2636.32

SOURCE: Based upon operators' share of return to capital and family labor from business analyses reporting capital assets.

a/ Significance level, two-tailed test: * ≤ .10, ** ≤ .01.

Table 26. RETURN TO CAPITAL AND FAMILY LABOR - ANALYSIS OF VARIANCE FOR THE REGRESSION

Variation Source	Degrees of Freedom	Sum of Squares	Mean Squares	F[a] Value
Attributable to Regression	11	287.7077×10^8	26.15525×10^8	146**
Deviation from Regression	3268	585.9317×10^8	$.1792936 \times 10^8$	
Total	3279	873.6394×10^8		

[a] Significance level, two-tailed test: ** $\leqq$ .01.

Intercorrelations Between Variables in the Study

Although there were 74 variables in the investigation, this section deals only with the 14 which were used in multiple regression analysis. Eleven independent variables were selected because of their expected usefulness in predicting "total farm sales," "labor earnings," and "return to capital and family labor." Table 27 shows the intercorrelations between the 14 variables. Those correlations that are statistically significant at the .05 and .01 level are appropriately labelled. Because of the large number of observations (3,280), relatively small correlations were significantly different from zero.

The correlation coefficients most important to this study are those between record number and the other variables. A high positive correlation indicated that as farm operators participated in the farm management education program for a longer period of time, the variable with which record number is correlated also increased in size or value. All except 4 of the variables were significantly positively correlated with the record number. "Record number" was correlated most highly with "total farm sales," "labor earnings," "return to capital and family labor," and "livestock units per 100 acres."

Another set of important correlation coefficients involved three criterion measures of the returns to education: "total farm sales," "labor earnings," and "return to capital."

All 11 variables were significantly related to "labor earnings." The extremely high correlation between "return to capital" and "labor earnings" reflected the inter-related nature of these two measures of farm income. The relatively

Table 27. CORRELATION COEFFICIENT MATRIX FOR 14 VARIABLES USED IN MULTIPLE REGRESSION

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Rec. No.	1.000	.067*	.012	.116**	.102**	.105**	.044	.121**	.083**	.072*	-.025	.080*	.088**	-.015
2. Tot. Cap.		1.000	.081**	.533**	.323**	.489**	.084**	.174**	.456**	.243**	.445**	.342**	.234**	.368**
3. Inc. Work Off Farm			1.000	.082**	.096**	.101**	.006	-.031	.061	.013	.204**	-.080*	-.032	.156**
4. Tot. Farm Sales				1.000	.354**	.392**	.041	.421**	.570**	.249**	.257**	.326**	.232**	.196**
5. Labor Earnings					1.000	.949**	.205**	.121**	.299**	.234**	.219**	.232**	.318**	.176**
6. Return to Capital						1.000	.224**	.124**	.351**	.250**	.272**	.317**	.339**	.215**
7. Index of Crop Yields							1.000	.098**	.193**	.034	.004	.055	.243**	.004
8. Lvstk. Units per 100 A.								1.000	.469**	.319**	-.196**	.410**	.313**	-.251**
9. Work Units									1.000	.536	.365**	.673**	.393**	.254**
10. Work Units per Worker										1.000	.170**	.648**	.519**	.078*
11. Work Units on Crops											1.000	.061	.069*	.776**
12. Work Units on Lvstk.												1.000	.558**	-.017
13. Factors Above Ave.													1.000	-.021
14. Total Land														1.000

* Significant at the .05 level with 1000 degrees of freedom (number of observations = 3280).

** Significant at the .01 level with 1000 degrees of freedom (number of observations = 3280).

large correlation coefficient for "labor earnings" and "total farm sales" was expected since "labor earnings" is generally considered to be a function of business volume.

Generally, the same relationships hold between "return to capital" and the other variables as between "labor earnings" and the 11 independent variables. However, in each case, the correlation coefficients are larger for the "return to capital."

"Work units" and "total farm capital" are the variables most closely related to "total farm sales." Although both "work units on crops" and "work units on livestock" were related to sales, "livestock work units" had a higher correlation coefficient. The relationship between livestock and "total farm sales" was substantiated by the large correlation coefficient involving "livestock units per 100 acres" and "total farm sales."

There were 7 variables which this study originally intended to include in multiple regression analysis as independent variables predicting "labor earnings," "return to capital and family labor," and "total farm sales." Table 28 shows the correlation coefficients for these 7 variables and the 3 criterion variables.

"Work units" showed a high relationship to the 3 criterion variables. "Operator age," "education," and "operator's wife's education" are not very closely related to the measures of returns to educational investments. Although "years of farming experience" is significantly related to "sales" and "return to capital," the correlation is small and the number of observations is considerably smaller than for the other significant correlations.

Since older farmers started farming earlier and tended to have fewer "years of education," there were negative correlation coefficients for many of the relationships between "age," "year started farming," and "years of schooling."

Polynomial Regression

One of the primary purposes of this study was to determine whether the economic returns to adult farm management education were subject to the diminishing marginal returns effect. To study the nature of the changes in "total farm sales," "return to capital and family labor," and "labor earnings," the statistical method of curvilinear, or polynomial, regression was used. The method employed a series of polynomial equations of increasingly higher degrees until the best-fitting equation was calculated. The years of farm management instruction, measured by the number of farm business records analyzed, was the independent variable. Three measures of economic progress were

Table 28. CORRELATION MATRIX FOR 10 SELECTED VARIABLES

		1	2	3	4	5	6	7	8	9	10
1.	Tot. Farm Sales	1.000	.356**	.409**	.117**	.227**	.580**	.055	.068*	.058	-.103**
2.	Labor Earnings		1.000	.943**	.093**	.174**	.305**	.048	.049	.033	.053
3.	Return to Capital			1.000	.092**	.240**	.380**	.038	.056	.084**	-.105
4.	Record Number				1.000	-.021	.068*	.010	-.017	.216**	-.172**
5.	Tillable Acres					1.000	.312**	.033	.084**	.071*	-.122**
6.	Work Units						1.000	.023	.033	.046	-.099**
7.	Operator's Yrs. Educ.							1.000	.467**	-.309**	.293**
8.	Wife's Yrs. Education								1.000	-.186**	.197**
9.	Operator's Age									1.000	-.787**
10.	Year Started Farming										1.000

* Significant at .05 level with 1000 degrees of freedom.

** Significant at .01 level with 1000 degrees of freedom.

used in turn as dependent variables. Computations stopped when the next higher degree polynomial equation did not produce a further reduction in the sums of squares about the regression line.

If the test for significance of total regression was significant at the .05 level, the equation was examined to determine if the reduction in sums of squares over the previous equation was significant.[2] If the F value was significant at the .05 level, the equation was judged to be the best mathematical explanation of the relationship between the dependent and independent variables concerned. Dividing the sum of squares associated with regression by the total sums of squares provided an estimate of R^2 or the proportion of the variance accounted for by the regression function. The coefficient of determination, R^2, "is the proportion of the total sum of squares that is attributable to another source of variation, the independent variable."[3]

Initial individual differences in labor earnings for farmers who submitted their first record for analysis were substantial. In each of the 7 years, the standard deviation of labor earnings was larger than the mean labor earnings. A scattergram with the years of participation and labor earnings as coordinate points would have shown a rectangular or even circular pattern. Because there was such wide variation in individual economic progress data within each year, the most meaningful way to evaluate changes in return to additional years of instruction was to consider group means. Data were grouped according to two dimensions: (1) the fiscal year for which the farm business record analysis was completed, and (2) whether or not it was the first, second, third, or subsequent farm record submitted for analysis.

To make comparisons which could be summed across years, a method was developed to compensate for annual fluctuations of the economic cycle and price levels of farm income items.[4] The mean for the group of farmers who submitted their first record for analysis in each year was used as the basis for computing measures of economic progress for farmers with more years of educational investment. The first record group was assigned an index of 100 so that increases in economic returns would appear as indices larger than 100. Decreases in economic return were signified by indices less than 100 (see P. 52, 53).

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[2] Refer to Chapter III for an explanation of the statistical tests used in selecting the polynomial equation.

[3] See Chapter III, p. 50.

[4] Chapter III, p. 51-53, provided a detailed explanation of the rationale and methodology of using an index.

The general hypothesis tested in all the curvilinear regression analyses was that the measures of income would conform to a diminishing marginal returns curve by increasing for two or more years of education and then decreasing with added educational inputs.

Total Farm Sales

Because it has an effect not only on economic returns to the farmer but also to the community, total farm sales was an important measure of returns to investments in the adult farm business management education program. It was hypothesized that farm operators would experience increases in mean total farm sales with additional educational investments and that these increments would be subject to the diminishing marginal returns effect.

Figure 2 shows the relationship between mean total farm sales and participation in adult farm management education based upon all farmers enrolled from 1959 through 1965. A diminishing marginal return effect is not evident. The graph shows a slight decrease in expected mean sales from a little more than $20,000 for participants in the first year to about $19,000 in year three. In the fourth and all subsequent years, the mean sales increased at an increasing rate. After ten years of instruction, the sales were more than $25,000 in excess of sales for farmers who had only one year of farm business management education. The graph suggests a substantial degree of accuracy in describing the relationship between variables as shown by an R^2 of .497.

It was hypothesized that a plot of the relationship between indexed mean total farm sales and participation in adult farm management education would yield a curve similar to the graph of mean sales but would be somewhat smoother. Figure 3 supports the hypothesis by portraying a period of decrease in indexed mean sales from approximately 110 in the first year to 105 by the third year. As in Figure 2, the fourth and subsequent years show sales increased at an increasing rate to the tenth year in which the indexed mean value was 2.5 times that of the first year. The relationship between variables was defined with the same accuracy as in related Figure 2 with an R^2 of .469.

A diminishing marginal returns effect was expected for returns to investments in well-organized programs of farm management education. It was also expected that the returns would be generally higher than for all farmers in the study. Well-organized programs were previously defined as (1) being conducted by a full-time adult instructor and (2) being judged "excellent" by a panel of experts who considered both orientation of instruction toward farm business management topics and the degree of continuity of the instructional program.

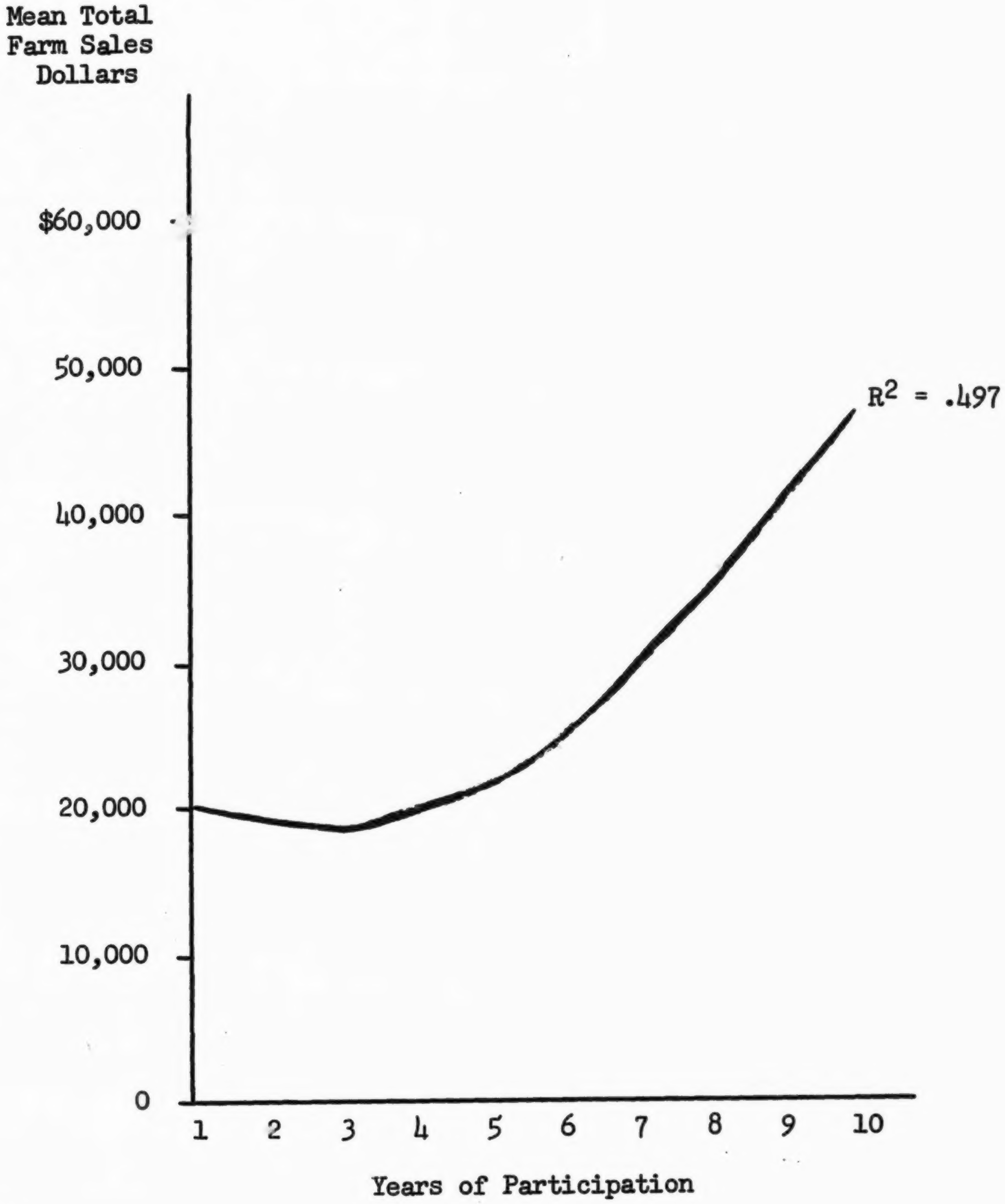

Figure 2. RELATIONSHIP BETWEEN FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965. See Appendix Table 36 for detailed data.

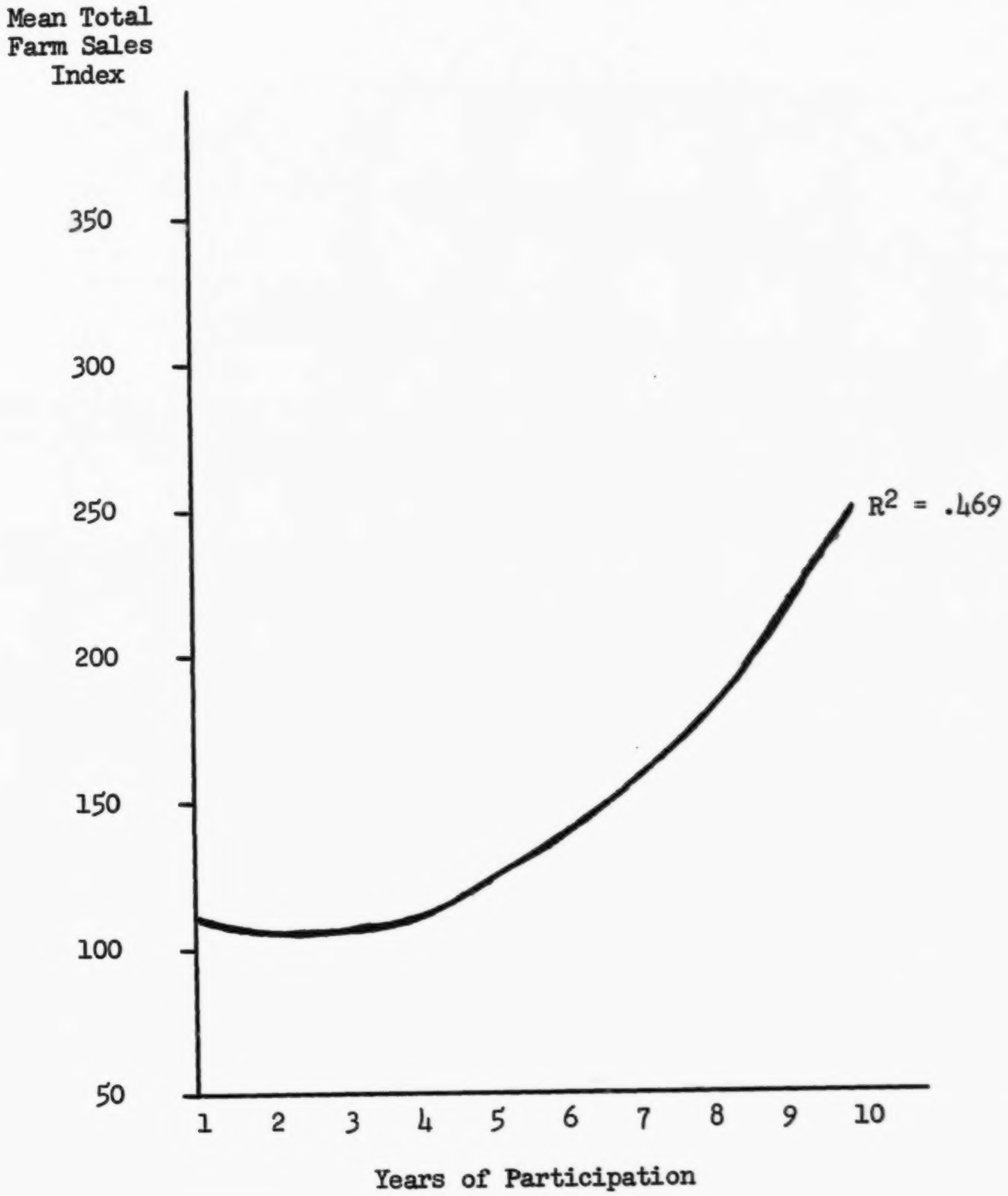

Figure 3. RELATIONSHIP BETWEEN INDEXED FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965. See Appendix Table 37 for detailed data.

Although Figure 4 reveals a relationship between mean sales and years of participation similar to that of Figure 2, it does not show a decrease in farm sales during the first two years. Rather, the graph reports an increase in mean sales from $19,000 to $21,000 in the first three years. Years three, four, and five had nearly the same value, but sales increased at a sharply increasing rate with subsequent increments of educational investment. At year ten, the mean value of total farm sales was almost $67,000 or $48,000 more than the mean sales for the first year. This was $23,000 more than the ten year gain for all farmers in the study as reported in Figure 2. The relationship between variables was very high as indicated by the R^2 value of .721 in Figure 4.

It was expected that if the relationship between indexed mean total farm sales and years of participation were plotted for farmers in well-organized programs, the resulting graph would be similar to the graph of mean total farm sales but would be somewhat smoother. After starting at an index of 105, Figure 5 shows the index to increase to about 120 at year two and level off until the sixth year. The indexed mean sales value increased at an increasing rate after the sixth year. With accuracy relatively high, as shown by the R^2 of .679, the indexed total farm sales at year ten is more than 3.85 times the value shown in the first year. This increase by year ten compared to an index of 2.5 for all farmers in the study suggested that the criteria used to distinguish well-organized programs from others had a significant relationship to the products of instruction.

Because the study measured returns to educational inputs, it was expected that the years of formal schooling completed by participants would positively influence the magnitude of their response to additional educational inputs.

According to Figure 6, the farmers with twelve or more years of formal education generally had higher indexed mean total farm sales than did those with less education. The relationship was accurately defined as the R^2 value of .998 indicates. While the farmers with less than twelve years of education responded positively to increments of educational input, they had generally smaller total sales, and it was more difficult to account for the variation in sales as the R^2 of .24 indicates.

Figure 6 shows that the indexed mean sales for farmers with more than twelve years of schooling started at about 75 in the first year, increased to nearly 125 in the second year, dropped to almost 100 in the third year, and then increased at an increasing rate to well over 375 in the eighth year. The index of total farm sales for farmers with less than twelve years of formal education started at close to 100 in year one, increased to about 112 in year two, and then decreased each

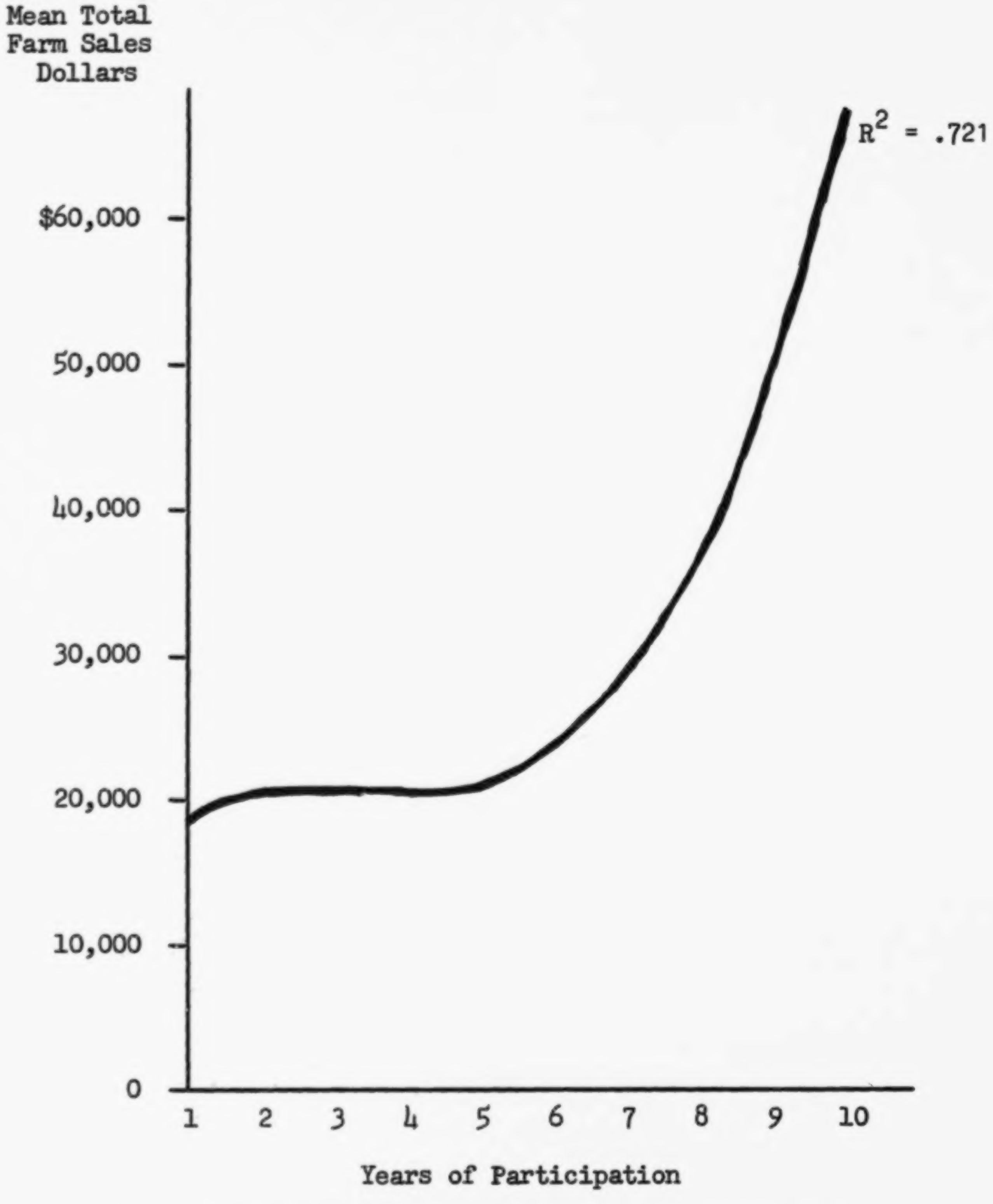

Figure 4. RELATIONSHIP BETWEEN FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - WELL-ORGANIZED PROGRAMS[a]

[a] Based upon all farmers enrolled in well-organized adult programs conducted by full-time instructors, 1959-1965.

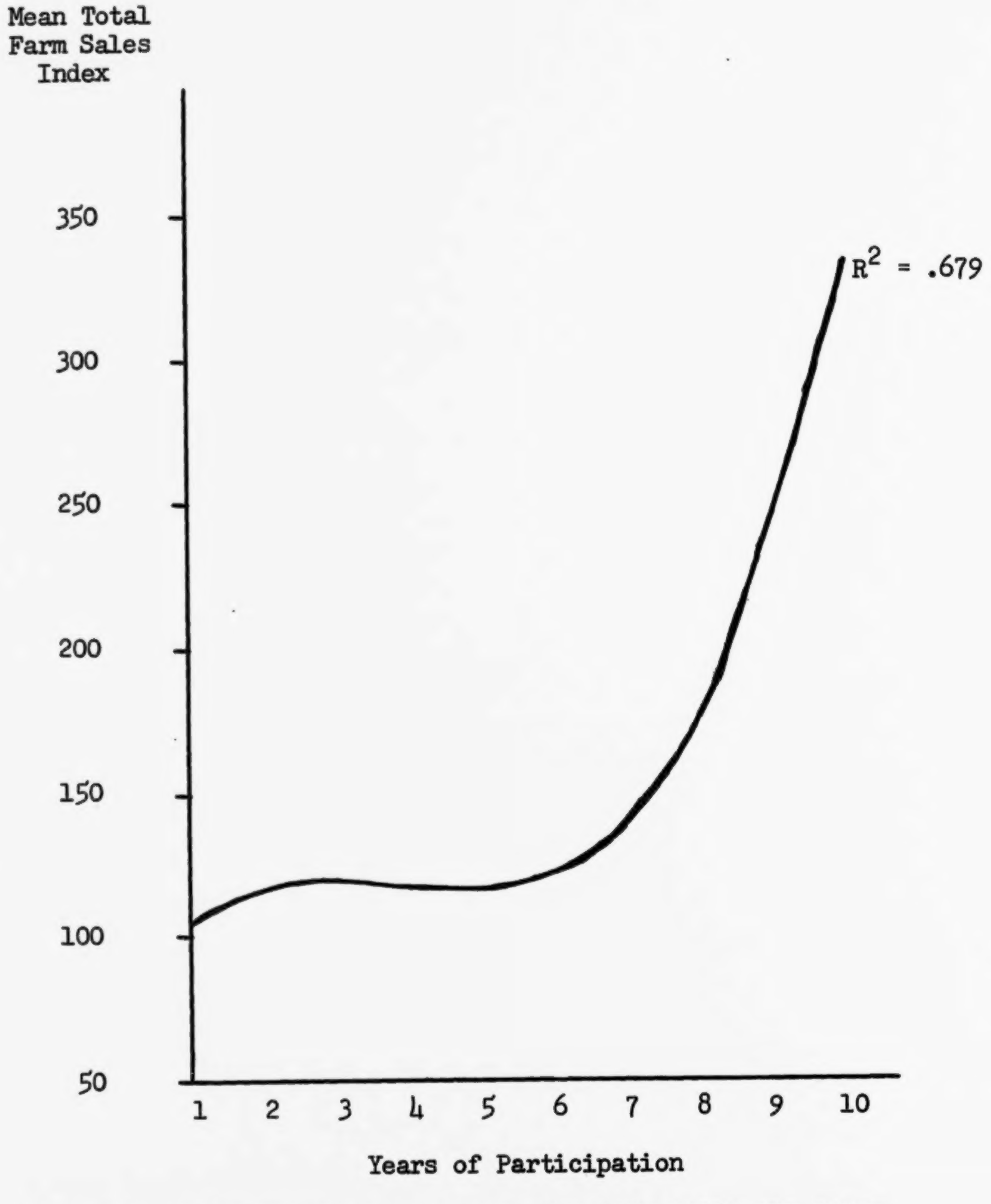

Figure 5. RELATIONSHIP BETWEEN INDEXED FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - WELL-ORGANIZED PROGRAMS[a]

[a] Based upon all farmers enrolled in well-organized adult programs conducted by full-time instructors, 1959-1965.

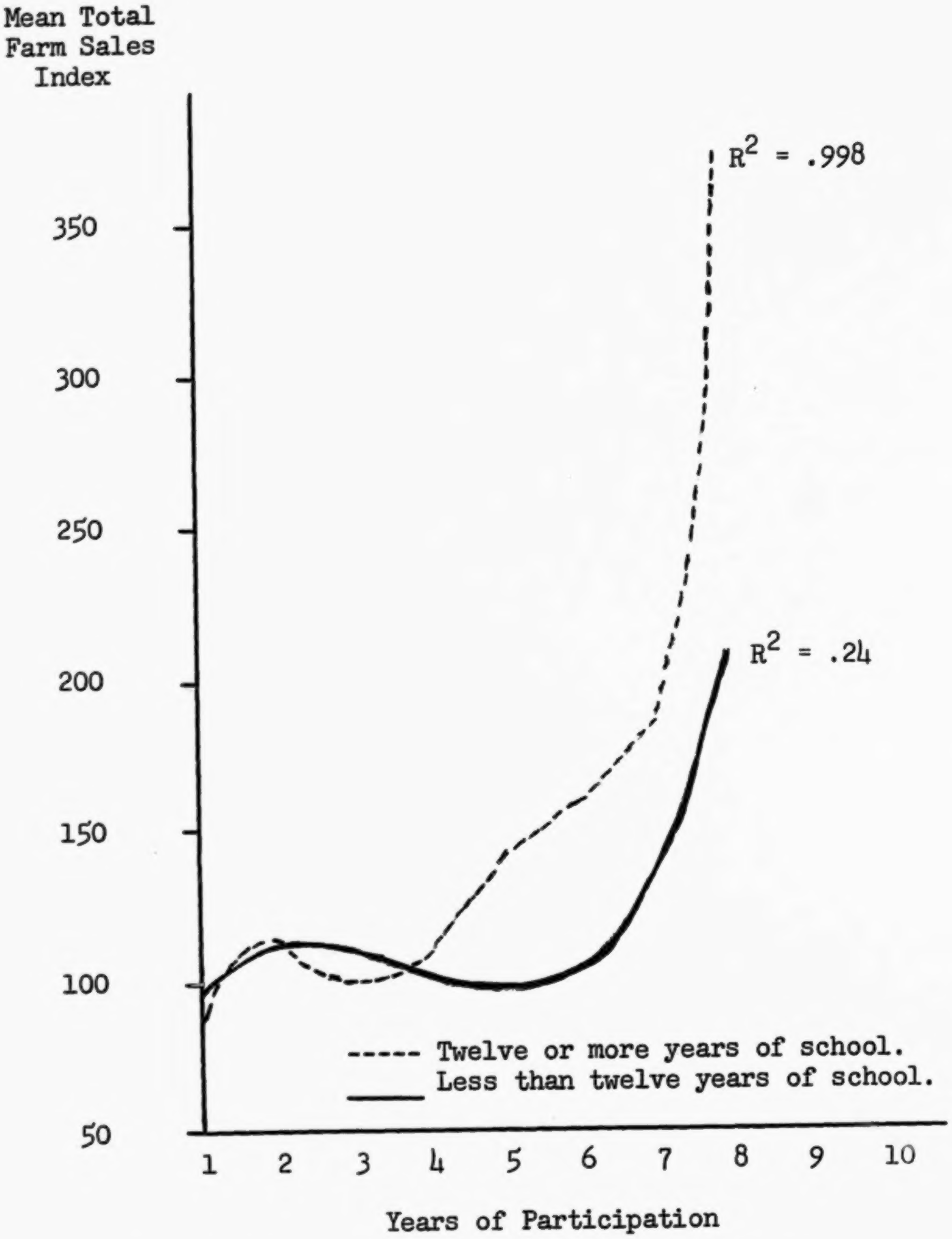

Figure 6. RELATIONSHIP BETWEEN FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - TWO LEVELS OF FORMAL SCHOOLING[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965.

year to year five where the index was again about 100. After the fifth year, the indexed sales increased at an increasing rate to approximately 212 at year eight.

The index of sales for the group with twelve or more years of education started lower than the group with fewer years of formal schooling, increased to a slightly higher value in year two, and then dropped to about a 10 per cent lower value by the third year. However, in the fourth and subsequent years, the group with 12 or more years of education maintained a substantial advantage over the group with less formal education.

Relationships between formal schooling and response to educational inputs of farm business management education should be examined in view of the interrelationships between formal education, age, tenure, and degree of establishment.

Some farmers submitted only one farm business record for analysis and then ceased to participate in the educational program. Farmers who showed persistence in the educational program by having two or more records analyzed were expected to exhibit somewhat different characteristics than those who dropped out after one year. There was, however, much similarity between all farmers in the study (including those enrolled for only one year) and those who were enrolled for two or more years. By excluding from calculations farmers who dropped out after one year, there was little change in the mean total farm sales from sales calculated from all participants. The mean for the first year, shown in Figure 7, was about $21,000. After a drop in year two to about $18,000, the mean sales increased at an increasing rate. By the tenth year, farmers in this subgroup showed an average of over $50,000 in sales. This was nearly $30,000 more than the mean sales for first-year participants. The proportion of variance accounted for was .411 or nearly the same as the R^2 for a similar calculation using all farmers enrolled as shown in Figure 2. Including farmers in the base year who did not continue in the educational program had little effect upon the outcome of the prediction equations.

Because mean sales for farmers who submitted at least two records for analysis were similar to sales for all farmers combined, it was hypothesized that by considering the index of sales there would be even more similarity between regression lines.

Although the R^2 in Figure 8 (.242) is somewhat less than the R^2 value shown in Figure 3 (.469), the graph is nearly the same. The indexed mean sales value (Table 8) was about 104 in the first year but decreased to nearly 100 in the second and third years. After the third year, the value increased at an increasing rate to approximately 260 in the tenth year.

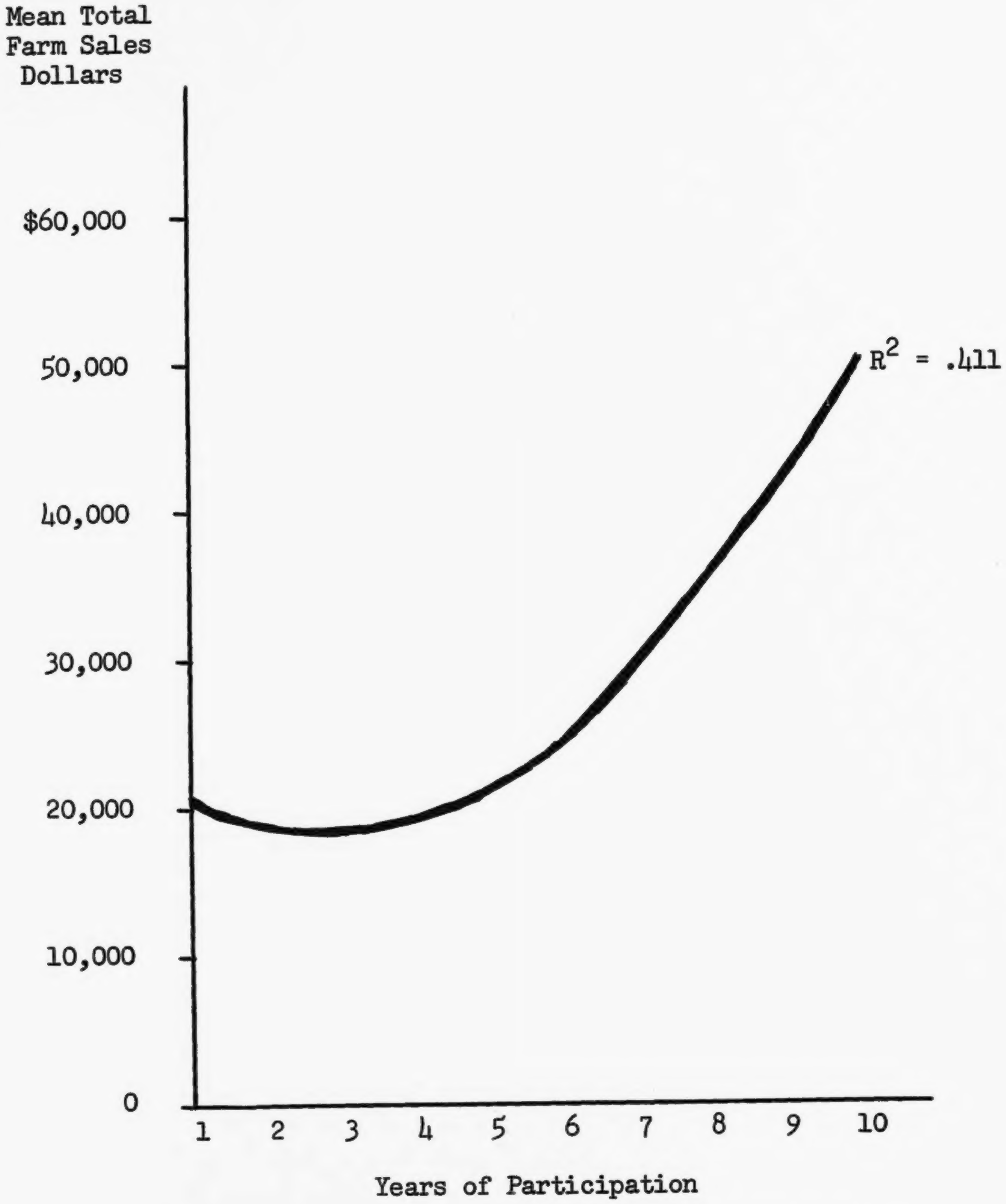

Figure 7. RELATIONSHIP BETWEEN FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - PERSISTENT ENROLLMENT[a]

[a] Based upon all farmers enrolled for two or more years in farm business management education, 1959-1965.

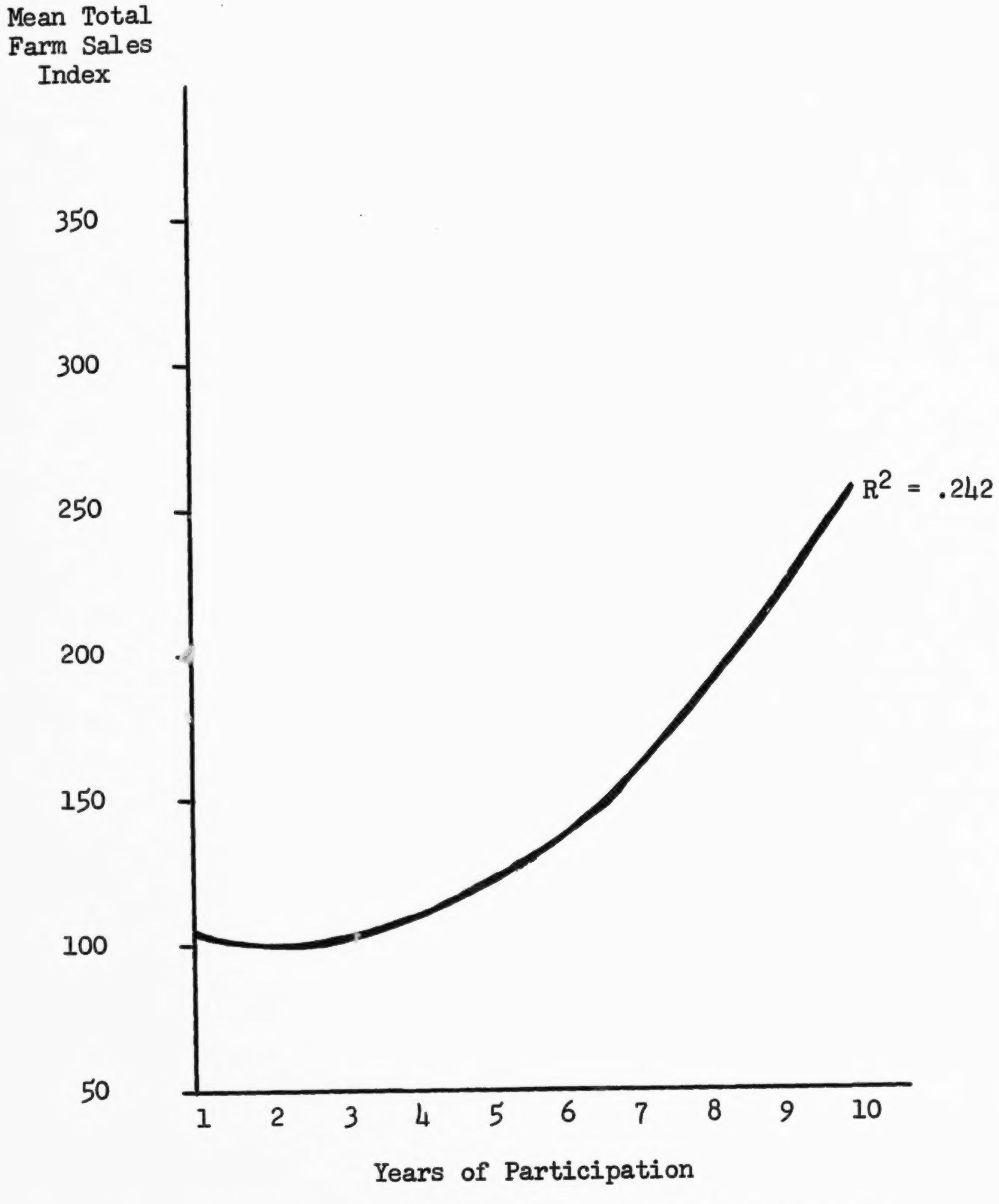

Figure 8. RELATIONSHIP BETWEEN INDEXED FARM SALES AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - PERSISTENT ENROLLMENT[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota who submitted two or more consecutive farm records for analysis, 1959-1965.

Return to Capital and Family Labor

Return to capital and family labor was a better measure of the total return to the farm business than was any other common economic measure. It reflected the total financial return to the business and included variations in contributions to income made by family labor and farm capital. It was hypothesized that return to capital and family labor would be subject to the diminishing marginal returns effect with added increments of educational investment.

Figure 9 shows the relationship between mean return to capital and family labor and participation in adult farm management education based upon all farmers enrolled from 1959-1965. The hypothesis of a diminishing marginal returns effect was not substantiated. The expected mean for the first year was $5,250; it decreased slightly to a somewhat smaller figure in the second and third years. In the fourth through the tenth years, the mean values increased at an increasing rate. The R^2 in Figure 9 suggests that about 31 per cent of the variation was accounted for. By the tenth year, the mean return to capital and family labor was over $10,500 - a gain of approximately $5,250 over the first-year average value.

It was expected that if the data upon which Figure 9 was based were converted to indices, a similarly-shaped but smoother line showing the relationship of the variables would result. As Figure 10 shows, there was a slight decline in indexed mean return to capital and family labor from the first to the second year. In the third year, the index increased to its first-year level and in the subsequent years increased at an accelerating rate. By the tenth year of participation, the index was over 1.8 times as large as the first-year value. The accuracy of the prediction (R^2) was the same, .311, for both Figures 9 and 10.

Because farmers in well-organized programs of adult farm management education underwent more intense educational investments, it was hypothesized that the general form of the relationship between mean return to capital and years of participation would be similar to that for all farmers but would show a greater response to the educational inputs. While the form of the graph in Figure 11 is similar to Figure 9, the increase in return to capital and family labor is much greater after the fourth or fifth year. As in Figure 9, the first-year value was about $5,250. Earnings decreased to slightly less in the second and third years, but, in the fourth year, the mean return to capital and family labor started increasing at a sharply accelerated rate. By the tenth year, the mean value was over $16,250. This sharp rise resulted in an increase of approximately $11,000 over the value for the first year and represented about $5,750 more return to capital and family

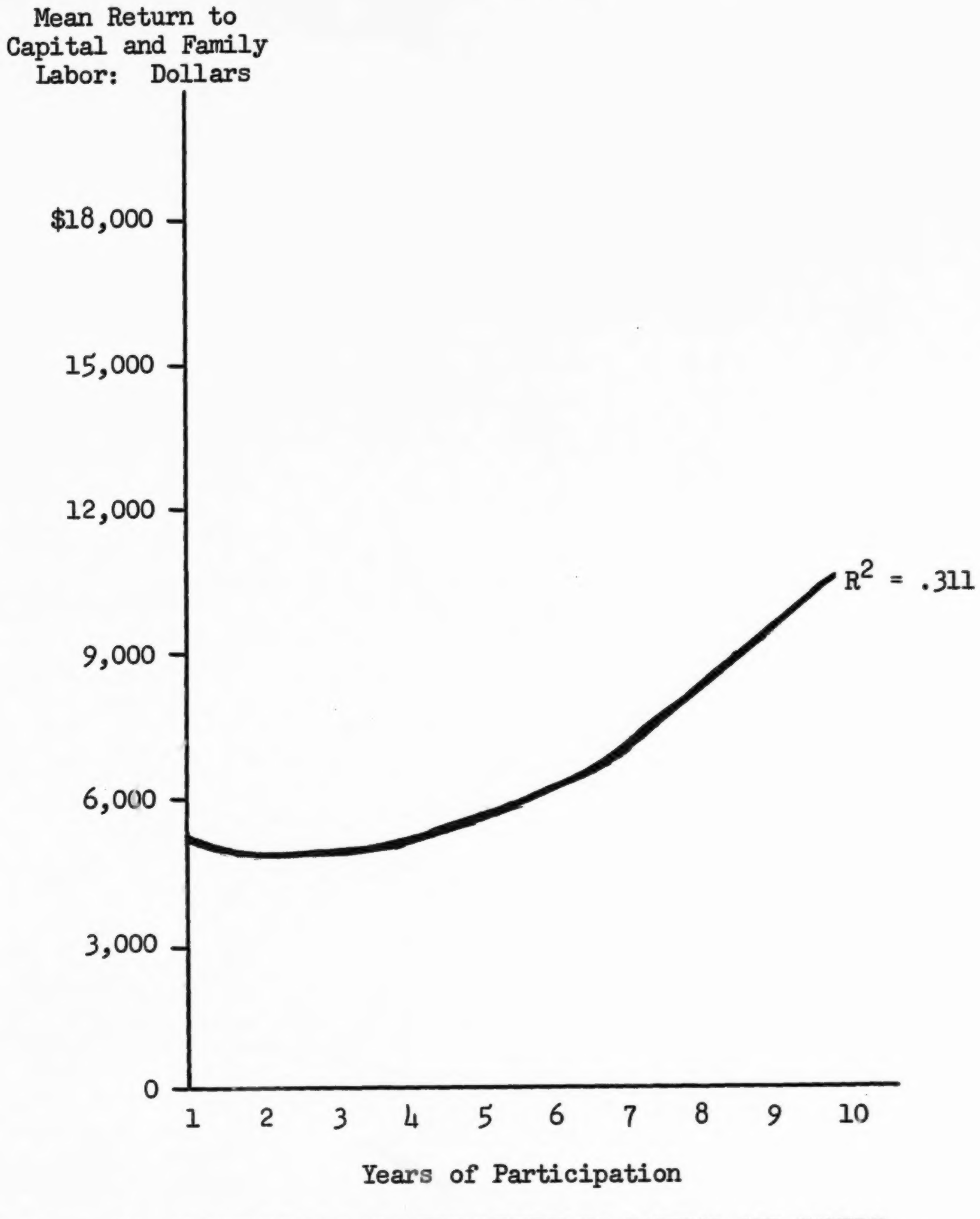

Figure 9. RELATIONSHIP BETWEEN RETURN TO CAPITAL AND FAMILY LABOR AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education programs, 1959-1965.

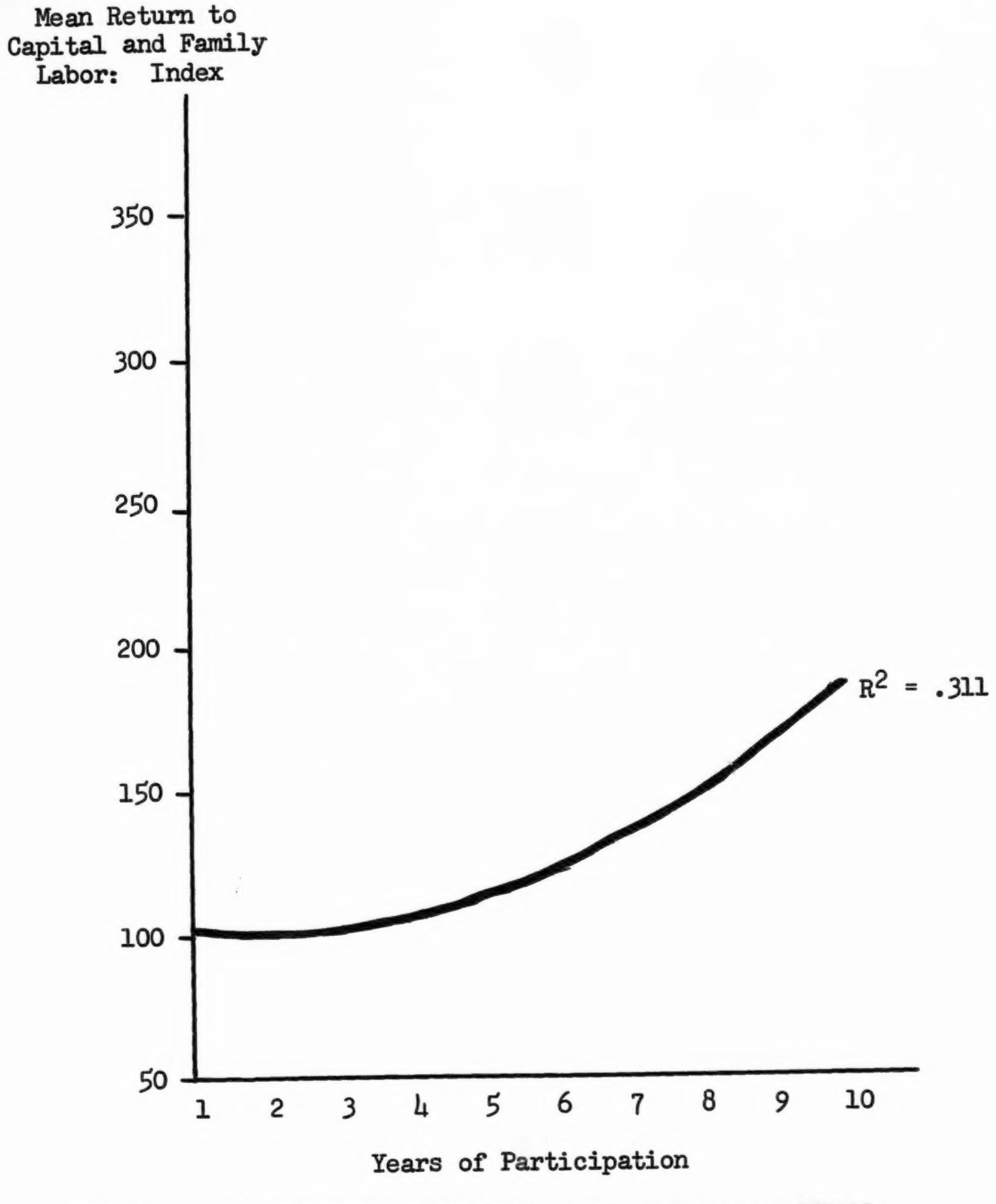

Figure 10. RELATIONSHIP BETWEEN INDEX OF RETURN TO CAPITAL AND FAMILY LABOR AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965.

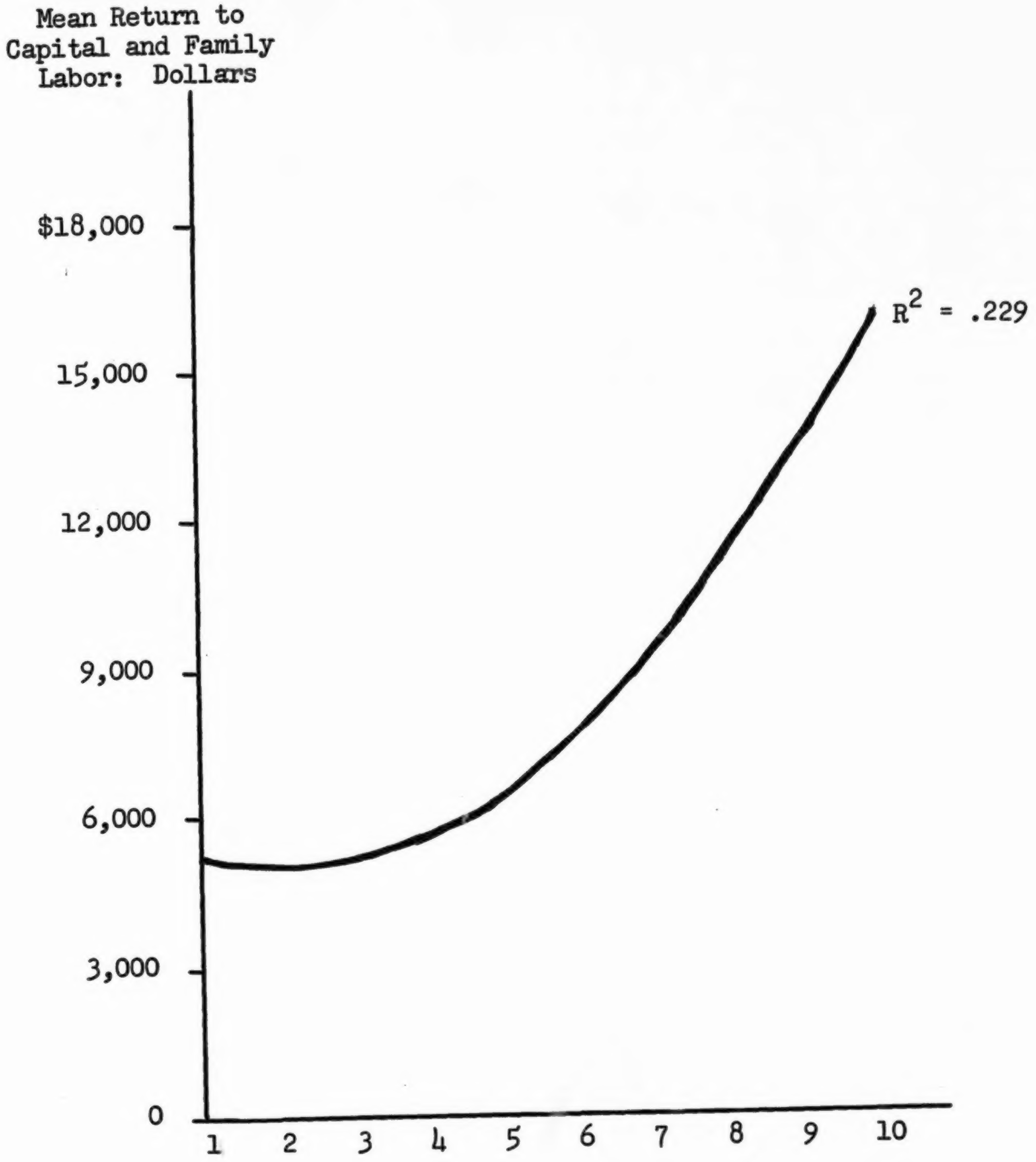

Figure 11. RELATIONSHIP BETWEEN RETURN TO CAPITAL AND FAMILY LABOR AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in well-organized farm business management programs in Minnesota, 1959-1965.

labor than the tenth year value reported in Figure 9. Figure 11 shows an R^2 value of .229.

It was hypothesized that the indexed mean return to capital and family labor for participants in well-organized programs would vary in much the same fashion as did the mean values reported for all participants. However, as Figure 12 shows, the best-fitting relationship was a straight line with an R^2 of .143. The straight-line relationship in Figure 12 starts at approximately 80 in the first year and goes to over 210 by the tenth year. The low R^2 value suggests only a limited relationship between variables for this sample subgroup.

Farmers who had twelve or more years of formal education were expected to react more positively to additional educational inputs than farmers with less education. Figure 13 supports the hypothesis except for the second year of instruction. The indexed mean return to capital of farmers with twelve or more years of schooling started near 100 but dropped to about 88 in the second year. In the third and following years, the returns increased at a decreasing rate to the sixth-year value of 125 and then increased at an accelerated rate to the eighth-year value of nearly 225.

The most striking characteristics of comparisons of return to capital and family labor of groups which have different levels of education are: (1) the consistent higher returns to the group with more formal education, and (2) the erratic response pattern and very low R^2 value, both indicative of a low relationship between variables for the group with the least formal education. Figure 13 shows the return to capital and family labor to be generally positive with added educational inputs.

Return to capital and family labor, which was partially dependent on level of capitalization, was expected to vary in response to different levels of beginning farm capital. As Figure 14 shows, there were different patterns of response to educational inputs according to the amount of beginning farm capital the subgroups reported in their first farm business record. All three subgroups showed an increase in their indexed mean return to capital, but the rates of increase varied. The subgroup with less than $30,000 beginning capital increased from an index of approximately 100 in the first year to an index of 170 by the sixth year. The subgroup with the next higher level of capitalization, $30,000 to $59,999, also showed a linear response to education. The indexed mean return to capital started at 100 but only increased to 150 by the sixth record. The proportion of variance accounted for in both subgroups was about 30 per cent.

Groups with high capitalization showed indexed return to capital values that increased sharply. The index of return to capital and family labor for the first year was less than 100

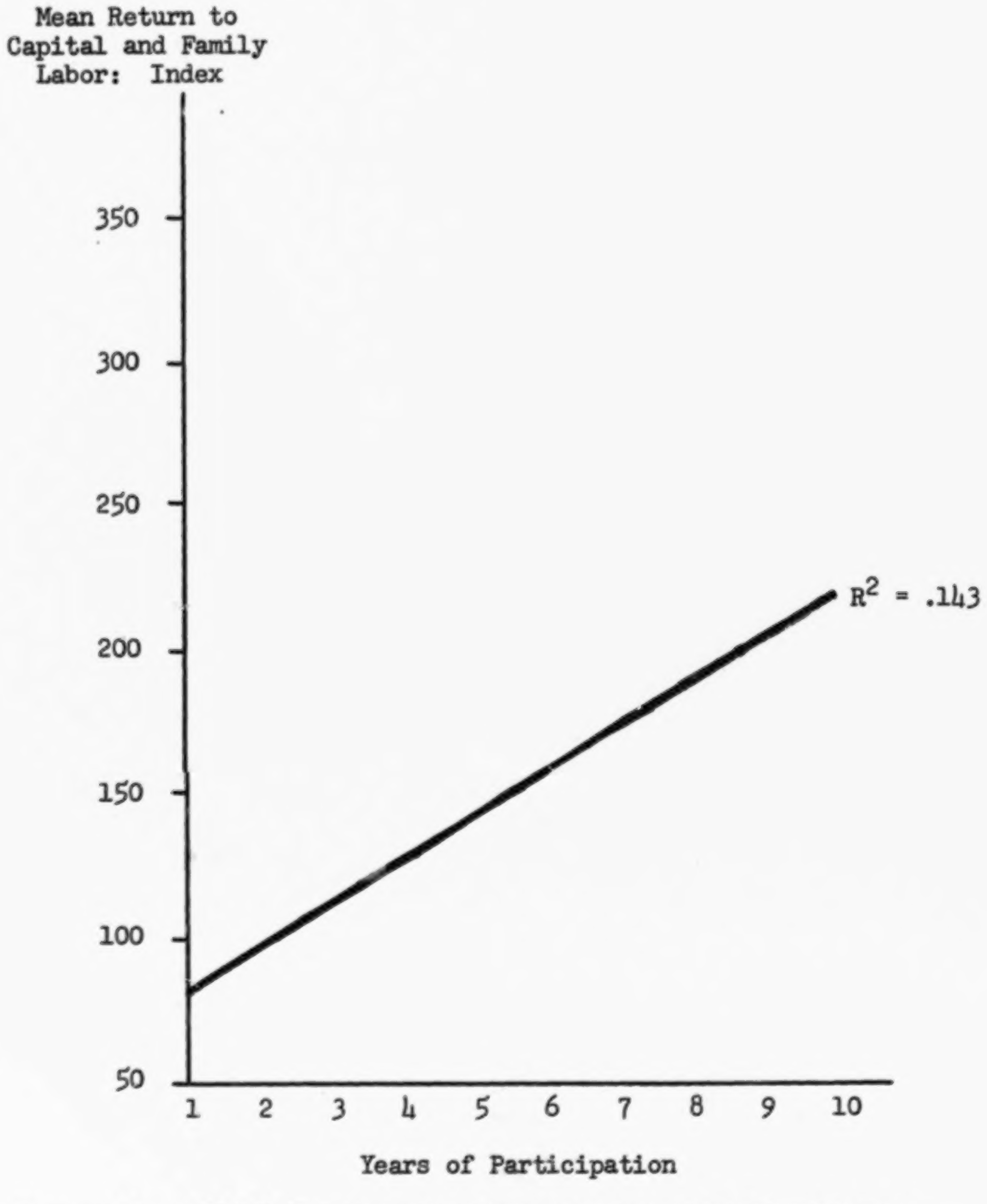

Figure 12. RELATIONSHIP BETWEEN INDEXED RETURN TO CAPITAL AND FAMILY LABOR AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - WELL-ORGANIZED PROGRAMS[a]

[a] Based upon all farmers enrolled in well-organized farm business management programs in Minnesota, 1959-1965.

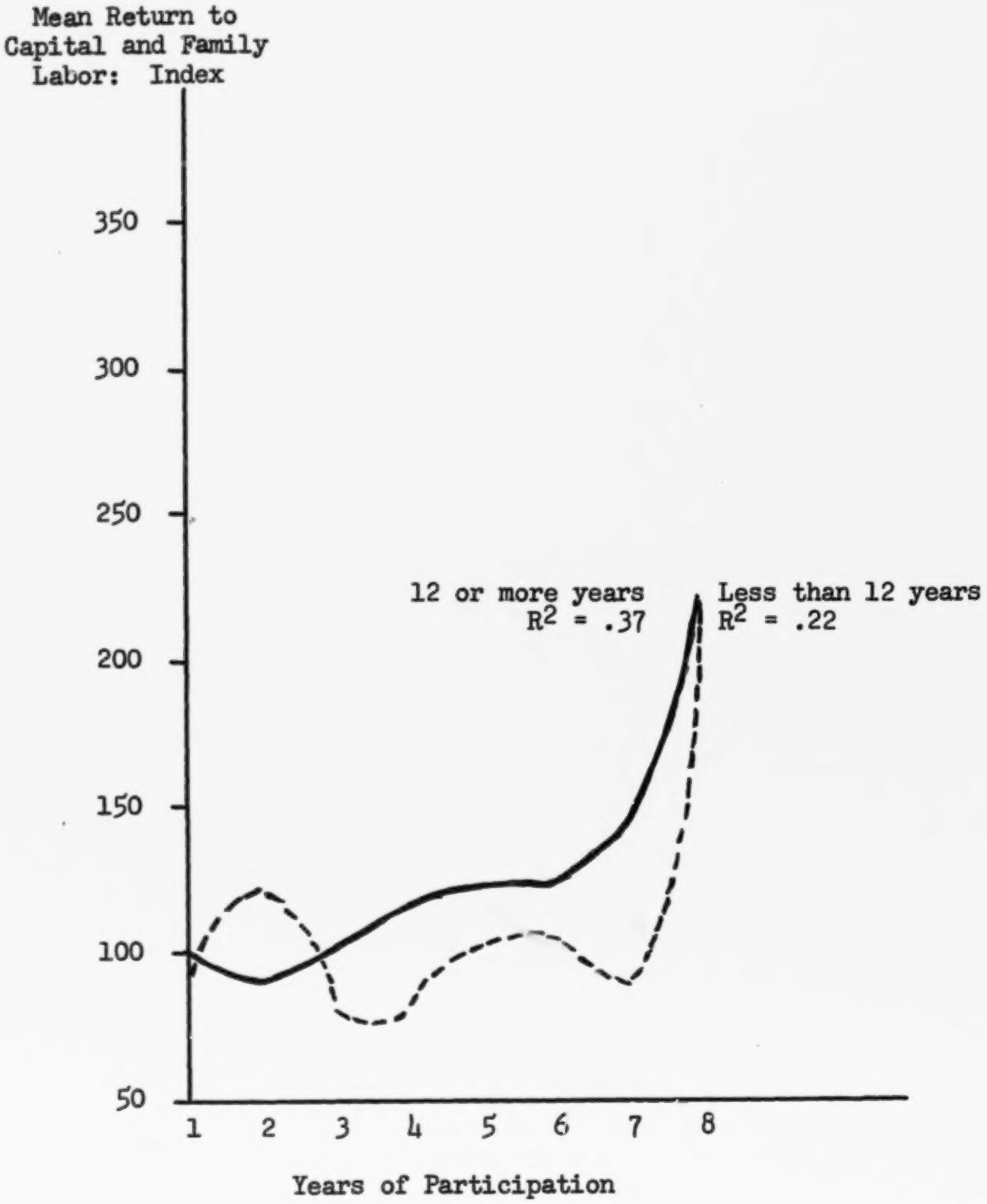

Figure 13. RELATIONSHIP OF INDEXED RETURN TO CAPITAL AND FAMILY LABOR TO ADULT FARM BUSINESS MANAGEMENT EDUCATION - TWO LEVELS OF FORMAL SCHOOLING[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965.

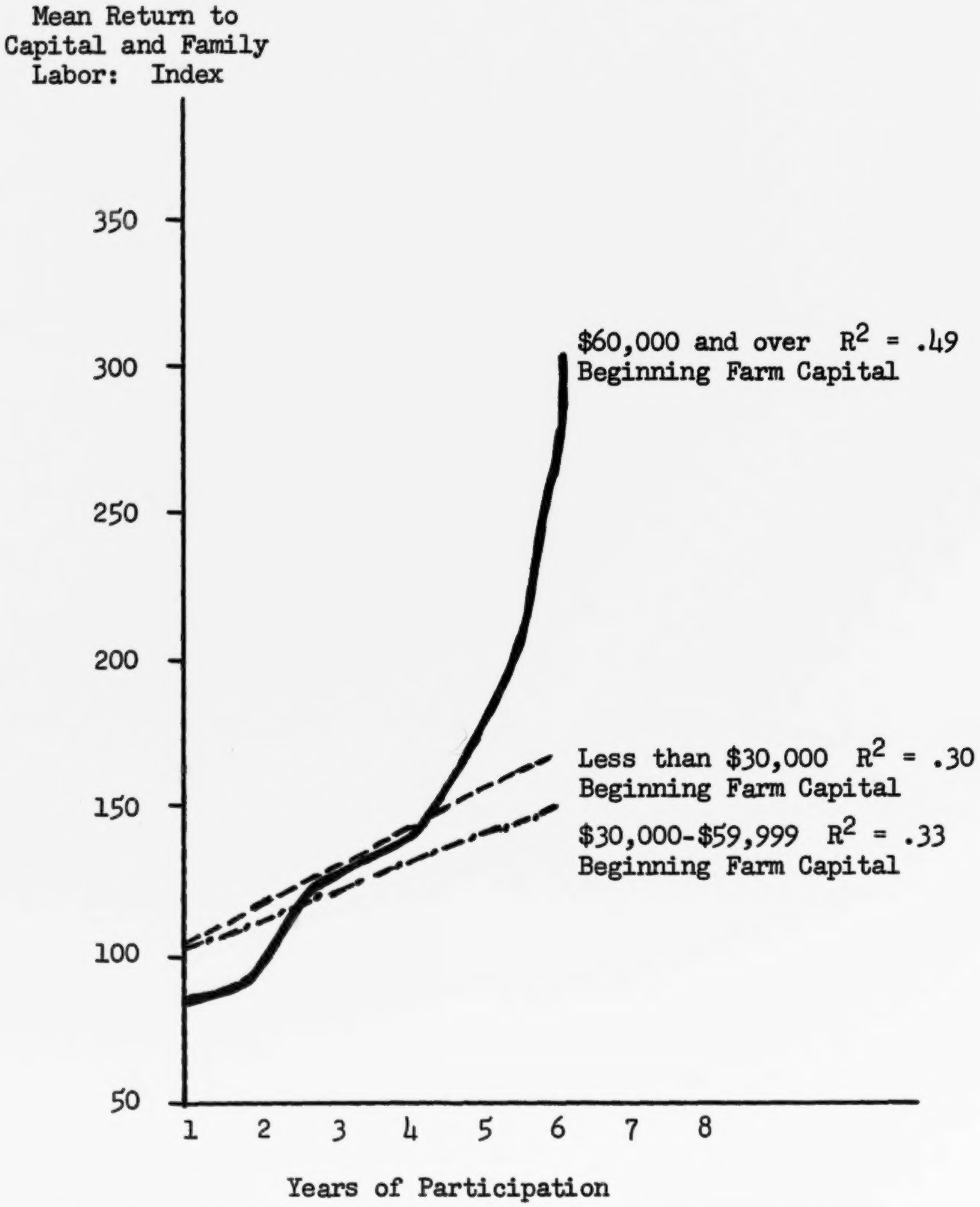

Figure 14. RELATIONSHIP OF INDEXED RETURN TO CAPITAL AND FAMILY LABOR TO ADULT FARM BUSINESS MANAGEMENT EDUCATION - THREE LEVELS OF BEGINNING FARM CAPITAL[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965.

but steadily increased until by the sixth record, the index was well over 3.5 times the first-year value. There was more accuracy in this prediction than for the subgroups with less beginning capital as indicated by the R^2 of .49 in Figure 14.

Farmers who submitted only one farm business record for analysis might have been different from other farmers who made larger investments in farm management education. It was hypothesized that an analysis excluding farmers with only one record would result in greater mean returns to capital and family labor than would an analysis which included all farmers in the study. The configuration in Figure 15, reporting the return to capital and family labor for the subgroup excluding first-year drop-outs, is similar to that for all farmers in the study. The mean value declined more between the second and seventh years of participation than when all farmers were included as shown in Figure 9. The value in Figure 15 is about $5,250 in the first year, but drops to $4,875 in the second year and continues down to nearly $4,500 by the third year. After the third year, the mean return to capital increased at an increasing rate. By the tenth year, the mean was up to over $11,000 or $5,750 more than the mean calculated for the first-year record group. While there was relatively little difference in tenth-year mean values between all farmers in the study and those enrolled for two or more years, the R^2 of .194 in Figure 15 shows that prediction was less accurate for the selected group.

A high degree of similarity was expected between the graph of means and the plot of indexed mean return to capital and family labor. Figure 16 shows a smoother graph but with similar shape to that in Figure 15. The first-year indexed mean value was 100 and dropped to around 90 by year three. The increase after the third year was at an increasing rate and shows a value of approximately 1.8 times the first-year value by the tenth year of participation. Accuracy of prediction was also similar to Figure 15 at .178.

Labor Earnings

Labor earnings measure the return to operators' labor after allowances have been made for the use of family labor and farm capital.

It was hypothesized that labor earnings would exhibit the diminishing marginal return effect with additional educational investments. Figure 17 illustrates the relationship between mean labor earnings and participation in adult farm management education based upon all farmers enrolled from 1959 through 1965. From a mean of $3,000 in the first year, the value increased to $3,500 in year two and to about $3,700 in year three. The mean value dropped in years four and five to

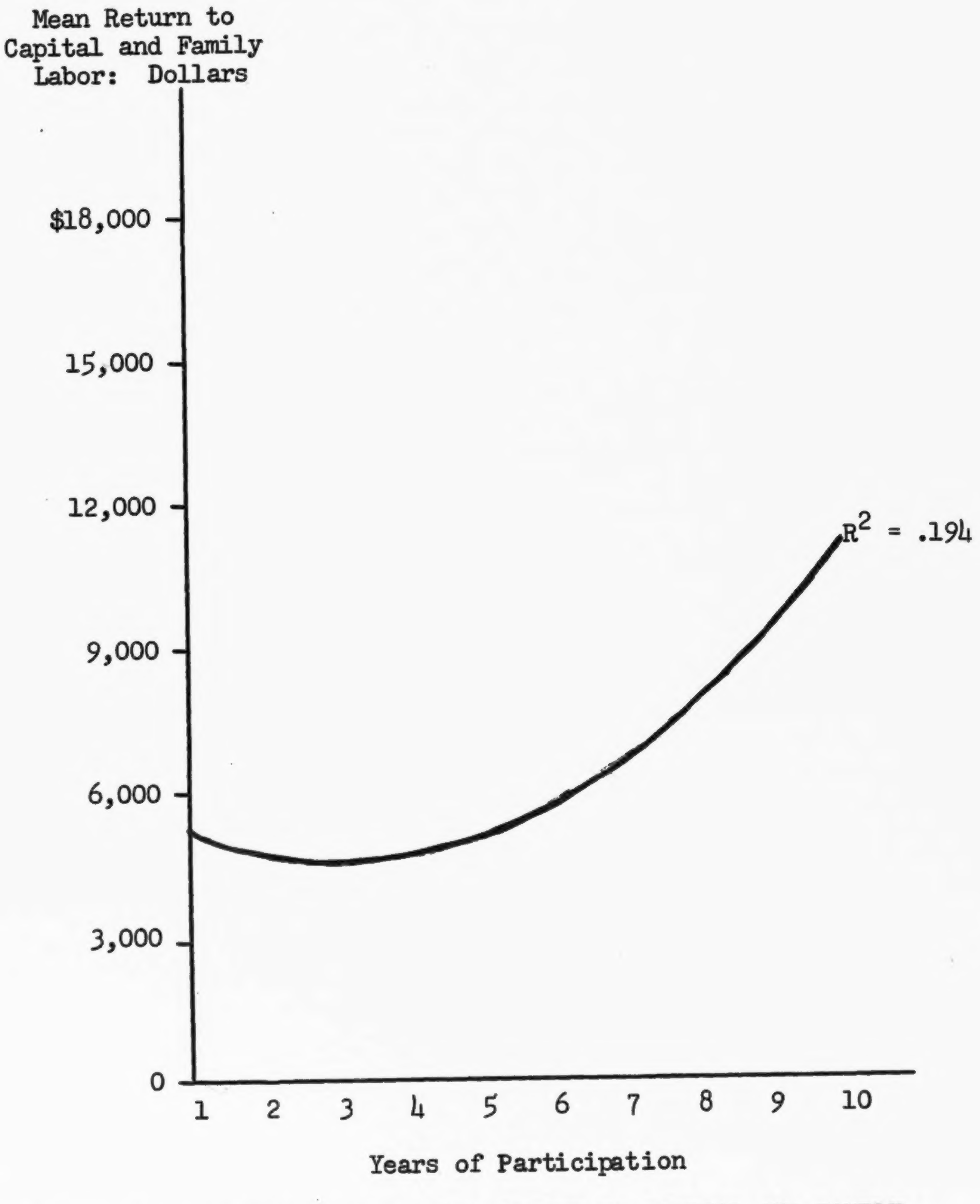

Figure 15. RELATIONSHIP BETWEEN RETURN TO CAPITAL AND FAMILY LABOR AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - PERSISTENT ENROLLMENT[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota who submitted two or more consecutive farm records for analysis, 1959-1965.

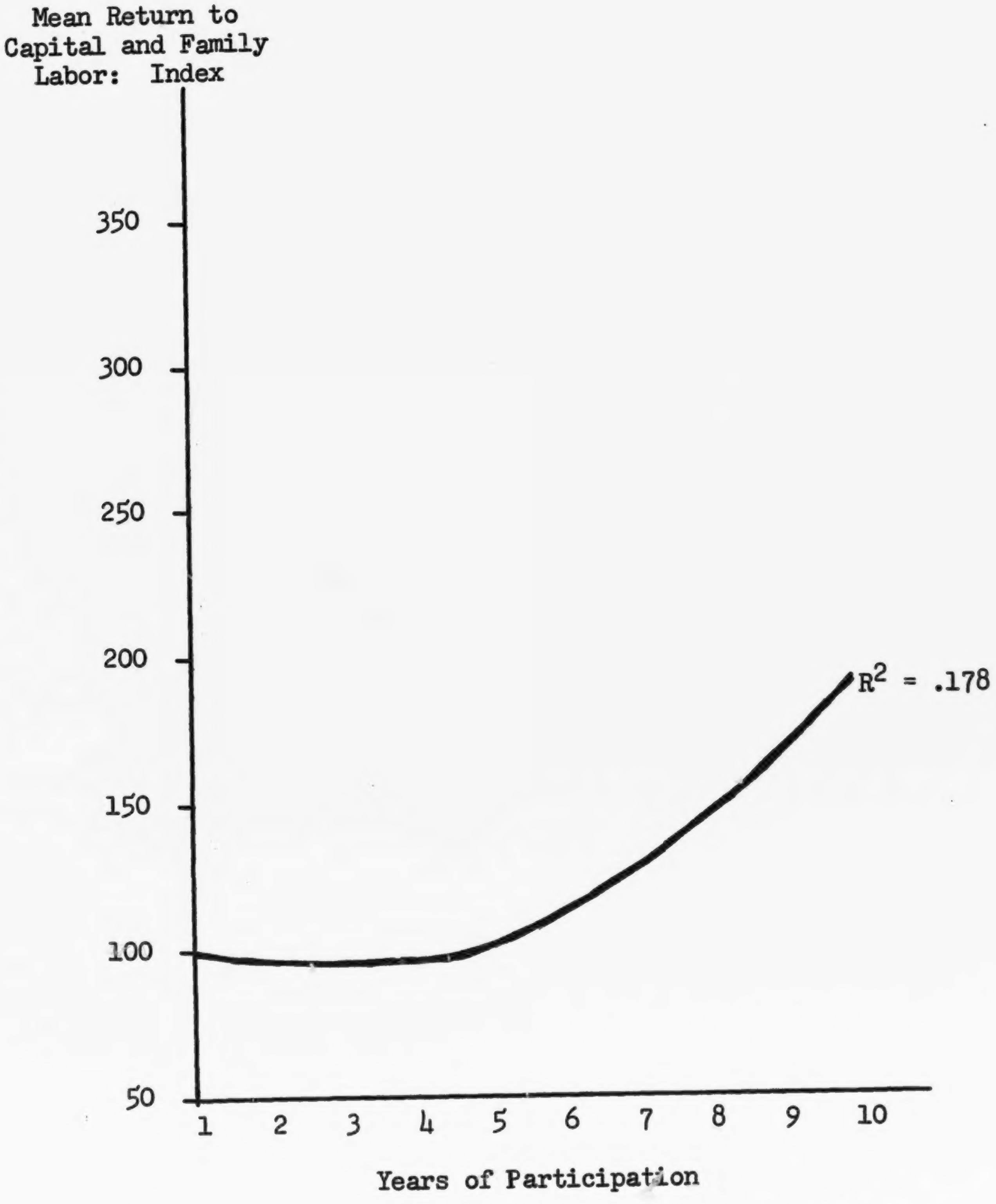

Figure 16. RELATIONSHIP BETWEEN INDEX OF RETURN TO CAPITAL AND FAMILY LABOR AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - PERSISTENT ENROLLMENT[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota for two or more consecutive years, 1959-1965.

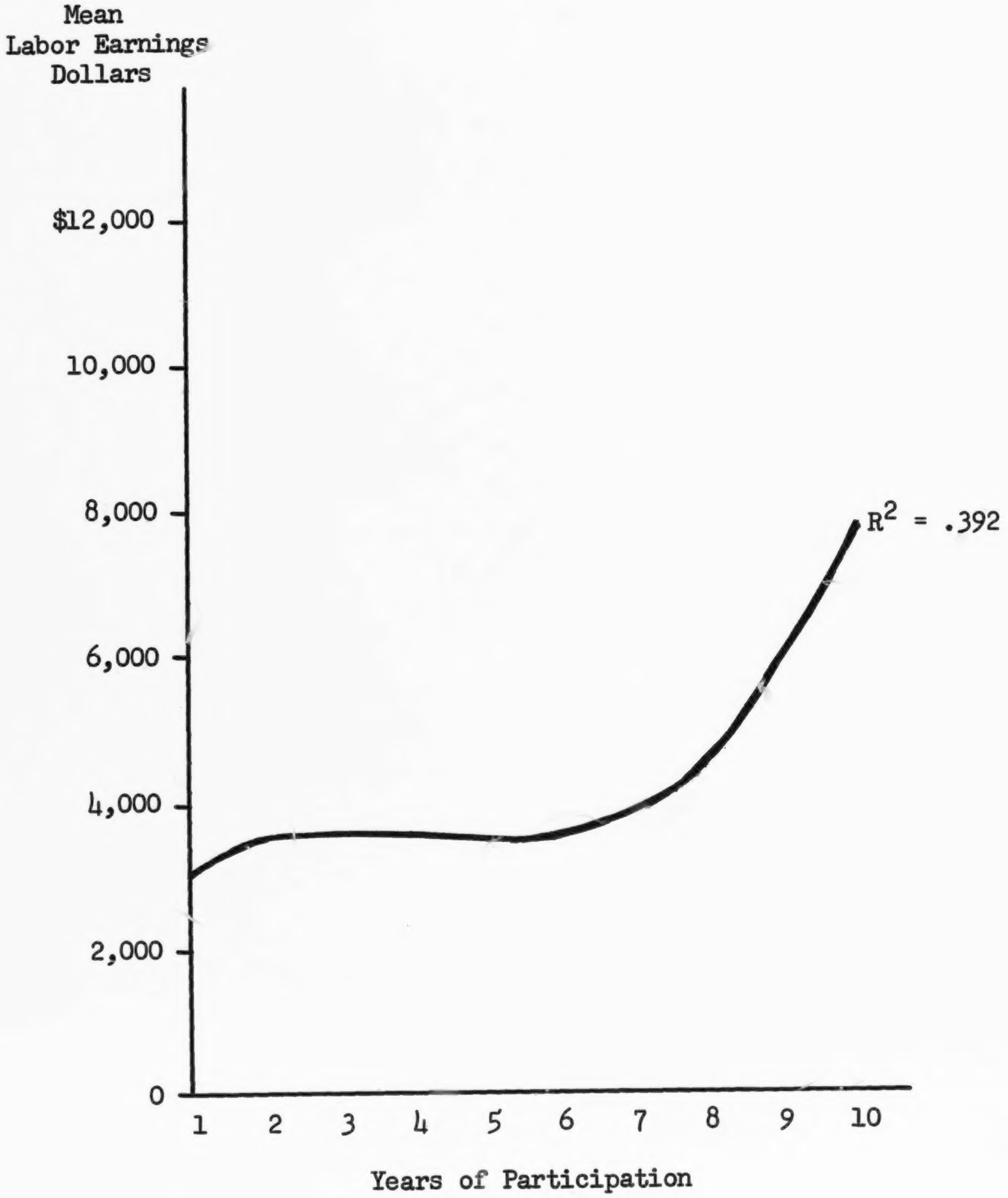

Figure 17. RELATIONSHIP BETWEEN LABOR EARNINGS AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education programs in Minnesota, 1959-1965.

about $3,500. At the sixth year, labor earnings began increasing. In subsequent years, mean labor earnings increased at an accelerated rate. By the tenth year of participation, farmers averaged nearly $8,000 in labor earnings. This represented a gain of nearly $5,000 over the mean value for first-year participants. The proportion of the variance accounted for by regression as indicated in Figure 17 was 39.2 per cent. While the diminishing marginal return effect may have operated during the first three years of instruction, later instruction shows earnings accelerate with added educational input.

It was expected that the graph in Figure 18, based on indices, would be similar to Figure 17 but would show less extreme fluctuation. After starting at less than 100, the indexed mean value increased to about 110 in year two and to nearly 115 by year three. The earnings were nearly constant from years three through six, but then began increasing at an accelerated rate. Farmers who participated for ten years had a labor earnings index twice as large as first-year participants. The R^2 for Figure 18 is .409.

Since educational investments made by farmers in well-organized adult farm management programs were considerably greater than for all farmers enrolled, they were expected to have higher labor earnings than all farmers in the study. As Figure 19 shows, the mean value for the first year was $3,000. It is particularly significant that earnings of the first-year group in well-organized programs was almost identical with the earning level calculated when all farmers were included. Labor earnings increased to nearly $4,000 in the second year and to over $4,000 by the third year. After the third year, the values dropped but not to a point below the starting value of $3,000. Earnings in the sixth year were about $3,700 but then began increasing at an accelerated rate. By the tenth year, the mean labor earnings were $10,500. As the R^2 of .510 in Figure 19 shows, half the variance in labor earnings was accounted for by farm business management education.

In general, the participants in well-organized programs had about the same initial income as all farmers in the study. Labor earnings increased more in the earlier years, dropped relatively more in years five and six, and finally reached a value by the tenth year approximately $2,500 higher than for all farmers in the study.

It was hypothesized that a plot of indexed mean labor earnings for participants in well-organized programs would be very similar to Figure 19. As Figure 20 illustrates, the fluctuation in index values is more pronounced than in Figure 19. In the first year, the indexed mean value is close to 100. Years two and three show increases to nearly 140.

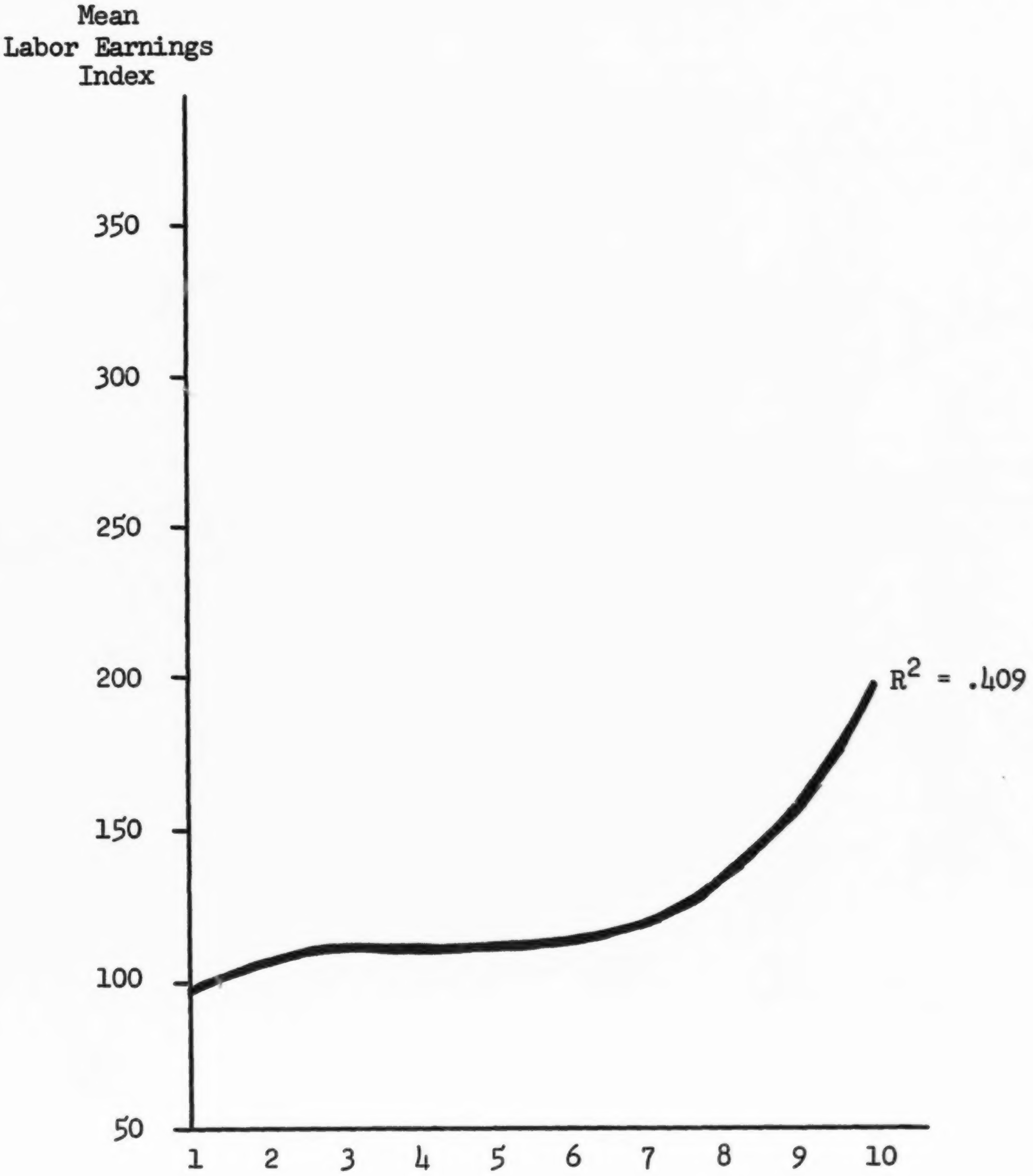

Figure 18. RELATIONSHIP BETWEEN INDEX OF LABOR EARNINGS AND ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota, 1959-1965.

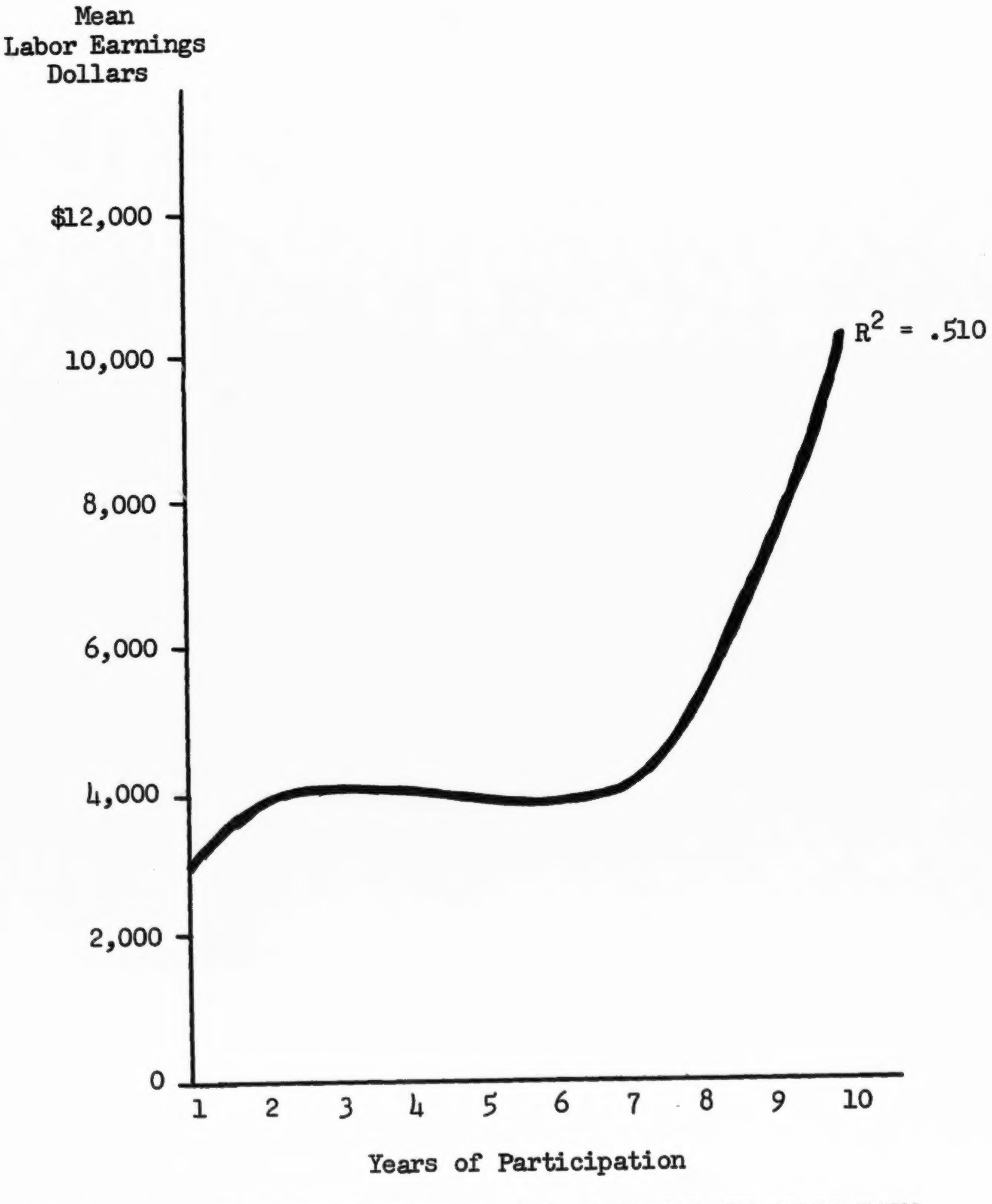

Figure 19. RELATIONSHIP BETWEEN LABOR EARNINGS AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - WELL-ORGANIZED PROGRAMS[a]

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[a] Based upon all farmers enrolled in well-organized farm business management education programs in Minnesota, 1959-1965.

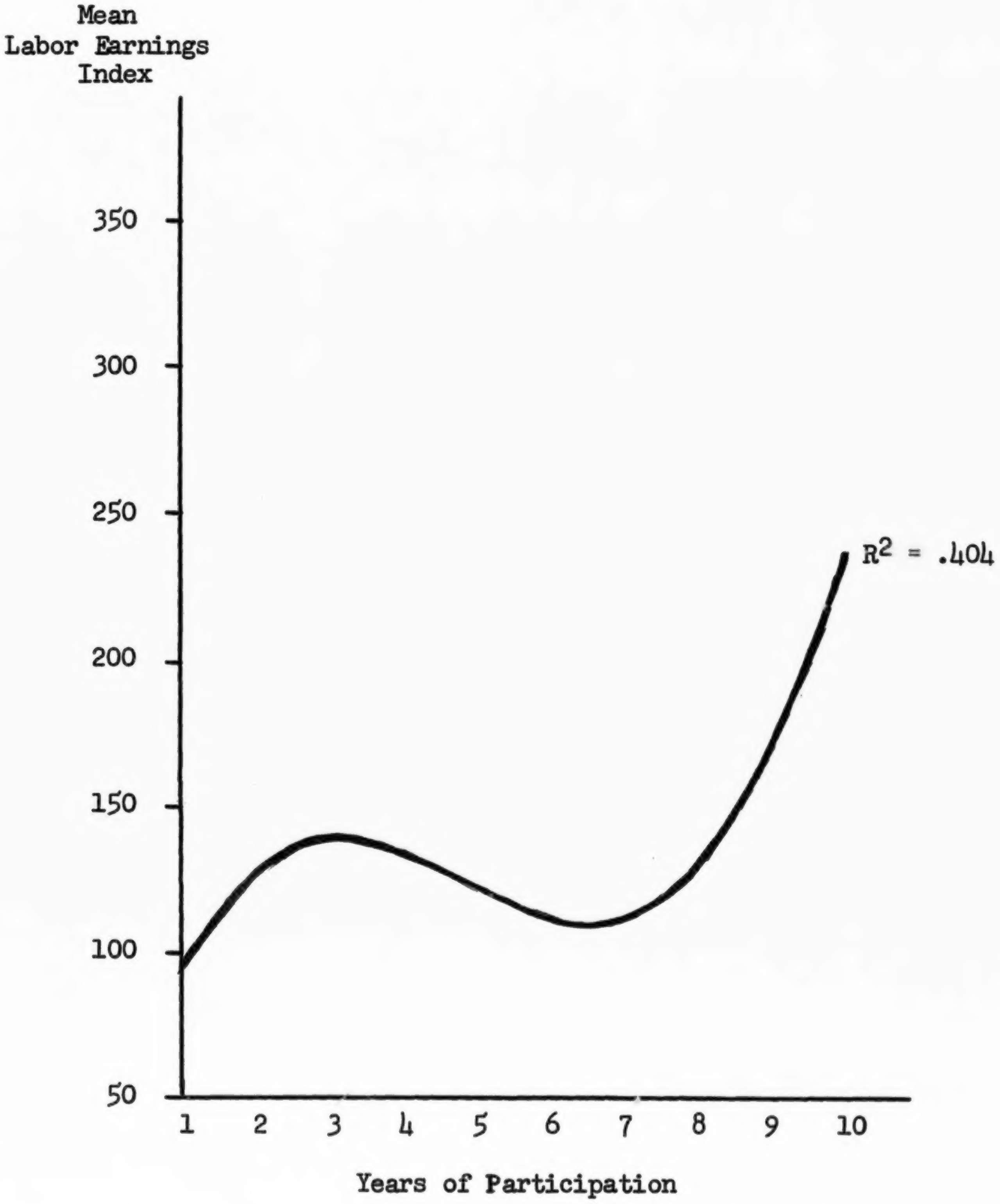

Figure 20. RELATIONSHIP BETWEEN INDEX OF LABOR EARNINGS AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - WELL-ORGANIZED PROGRAMS[a/]

[a/] Based upon all farmers enrolled in well-organized farm business management education programs in Minnesota, 1959-1965.

After the third year, the values decrease to a minimum point (near 110) in the seventh year. After the seventh year, the values increased sharply until by the tenth year the index of mean labor earnings was about 2.4 times as great as the indexed values for the first year. The proportion of the variance accounted for by regression was about the same as in the immediately preceding figures. An R^2 of .404 was calculated for Figure 20.

Farmers with twelve or more years of formal education were expected to have indexed mean labor earnings that would show a rapid rate of increase with additional educational investments. Figure 21 provides support for this hypothesis while showing a high correspondence between variables with an R^2 of .64. The indexed mean labor earnings were approximately 75 in the first year and remained near 100 in the second and third years. By the fourth year, the rate of increase became highly positive, and, after a drop from about 135 to 110 between years five and six, the indexed mean increased at an accelerating rate. By the eighth record, the index value was nearly 3.6 times as great as the first-year figure. In comparison, the index value after eight years for all farmers in the study was approximately 130. The farmers with twelve or more years of formal education responded to similar educational investments with a greater rate of increase in indexed mean labor earnings.

It was hypothesized that farmers would respond to educational investments in farm management education similarly regardless of their level of capitalization at the time they submitted their first record. The proportion of the variance accounted for in both of the prediction equations is illustrated in Figure 22. Low, yet significant, R^2 values of .21 and .13 were reported for the \$30,000-\$59,999 and less than \$30,000 groups, respectively. Both groups had indexed mean labor earning values that were best approximated by straight lines. The expected values for the less highly capitalized group started at 100 and increased in a linear fashion to 150 while the \$30,000-\$59,999 group had 5 to 10 per cent higher expected index values during all the years of participation.

Miscellaneous Variables

By holding beginning capital to a specified range, it was expected that capital would increase in constant and relatively small amounts with increments of educational investment. However, as Figure 23 shows, farmers with less than \$30,000 capital reported in their first record had indexed mean capital values that increased sharply, but at a decreasing rate, until the fourth year in which the expected value started increasing at an increasing rate. With 89 per cent of the variance accounted for, the graph of capital values for farmers with less than \$30,000 beginning capital pointed to an average index of capital in the sixth year of 2.5 times the first-year value.

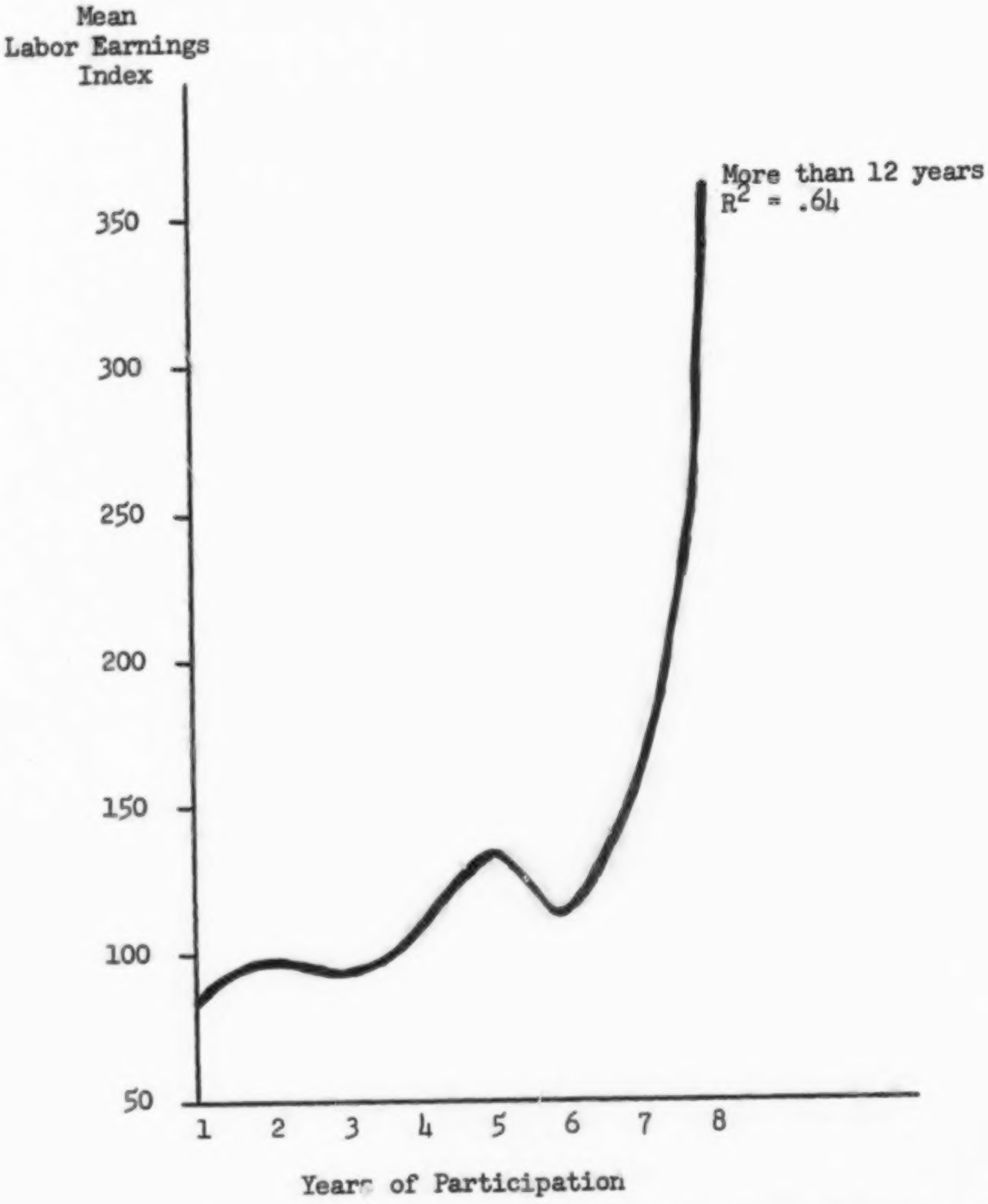

Figure 21. RELATIONSHIP BETWEEN INDEX OF LABOR EARNINGS AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - TWELVE OR MORE YEARS OF SCHOOL[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota who completed twelve or more years of school.

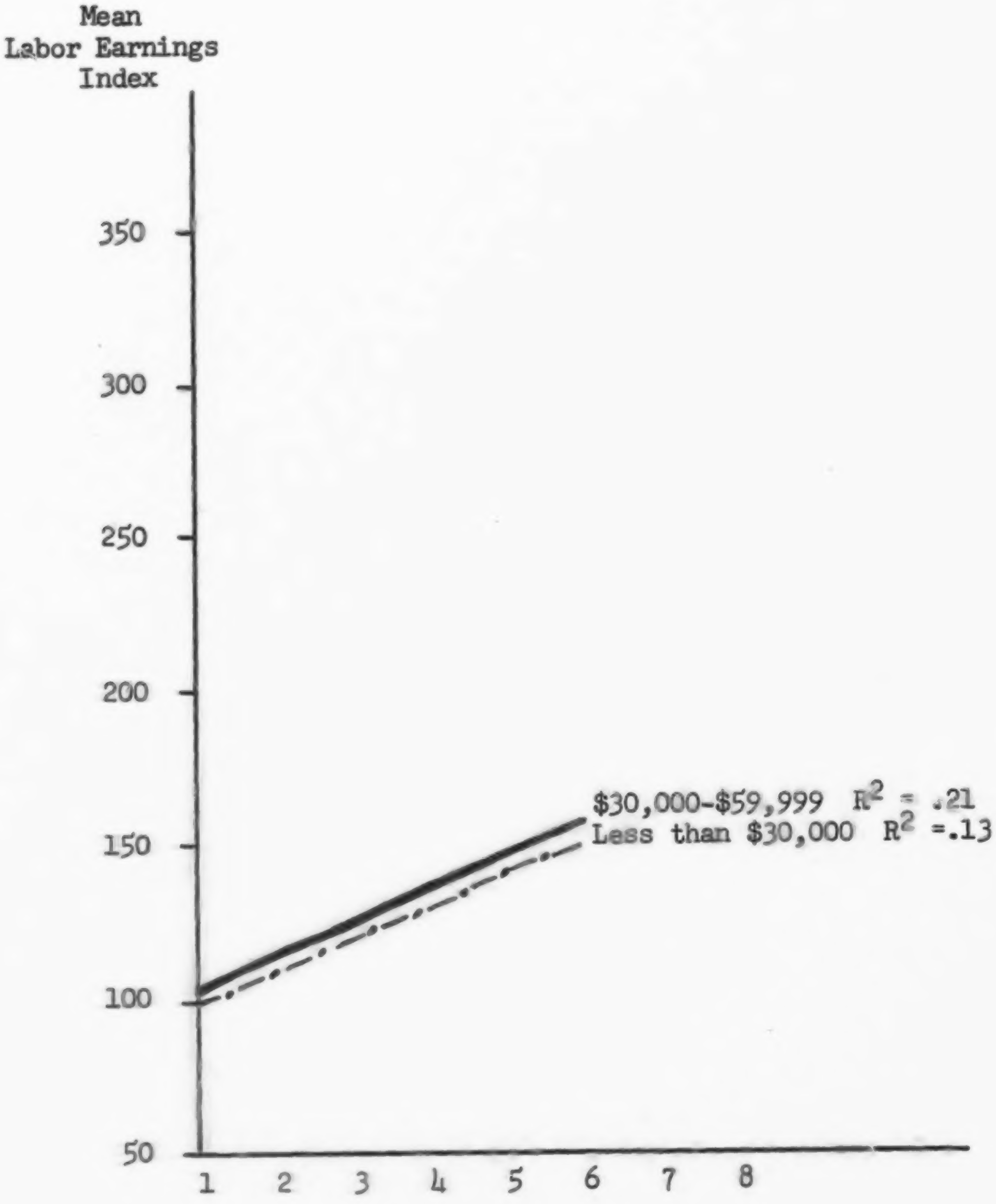

Figure 22. RELATIONSHIP BETWEEN INDEX OF LABOR EARNINGS AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - TWO LEVELS OF BEGINNING FARM CAPITAL[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota, 1959-1965.

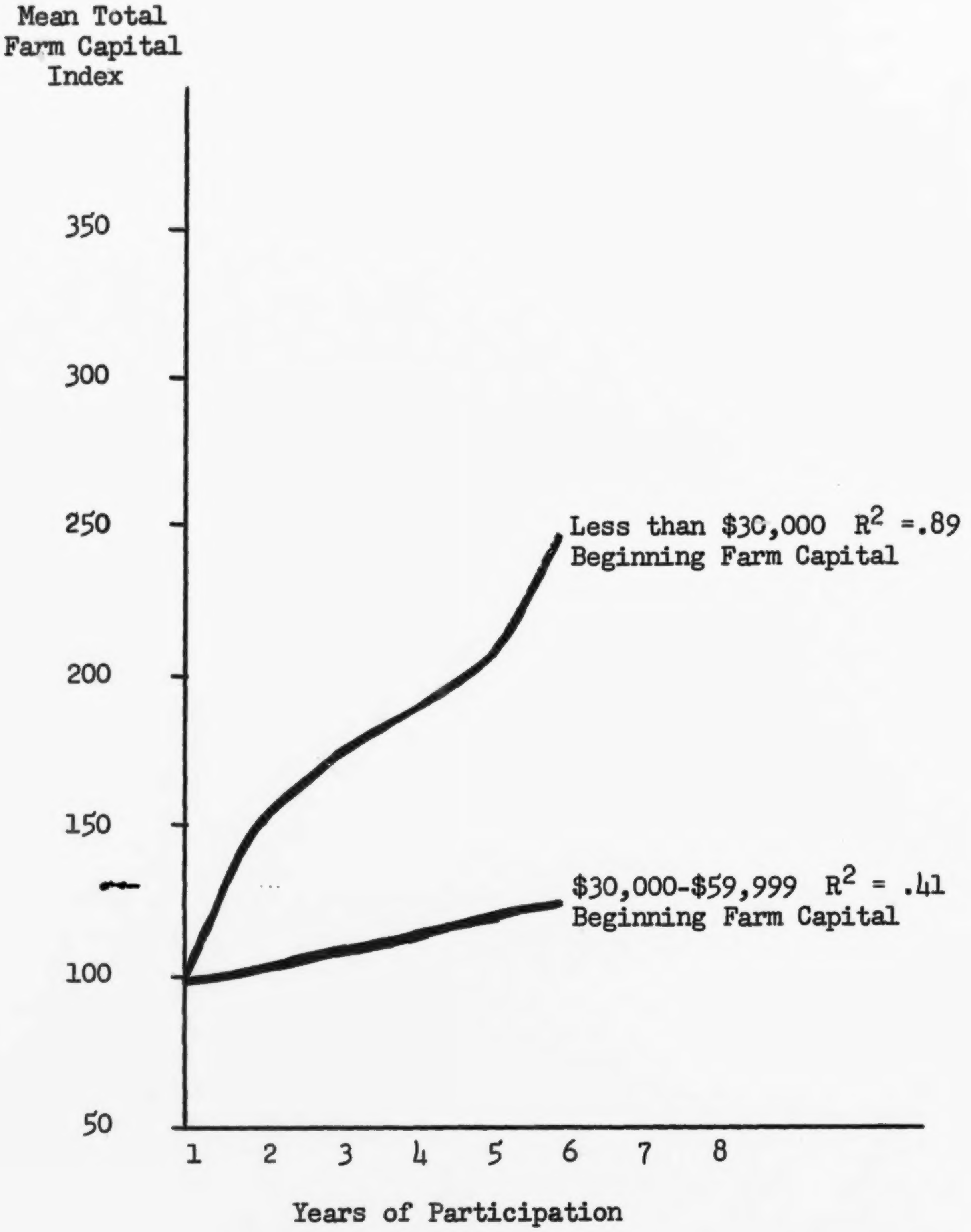

Figure 23. RELATIONSHIP BETWEEN INDEX OF TOTAL FARM CAPITAL AND ADULT FARM BUSINESS MANAGEMENT EDUCATION - TWO LEVELS OF BEGINNING FARM CAPITAL[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota, 1959-1965.

The other group of farmers, those with $30,000-$59,999 beginning capital, showed capital values more in accordance with the hypothesis of rather small but constant additions to total farm capital. With over 40 per cent of the variance accounted for, the plot of their indexed mean capital is a straight line starting at 100 in the first year and increasing to 125 by the sixth year.

When the index of mean values of all three indicators of the economic returns to investments in farm business management education were plotted on the same axis, it was hypothesized that all three would show nearly the same rates and amounts of change with added years of participation in farm business management education. Figure 24 illustrates the comparison among the relationships of the indexed means of labor earnings, total farm sales, and return to capital and family labor to participation in adult farm business management education based upon all farmers enrolled from 1959 through 1965.

In the first year, all three measures have values of approximately 100. Labor earnings showed the greatest rate of increase in years one through three and maintained an absolute advantage in the fourth year with a value of nearly 120. However, after the fourth year, the rates of increase of the index values of the other two indicators generally kept a numerical advantage over labor earnings. Towards the end of the ten-year period, the index value of labor earnings began increasing at a greater rate than the other two measures of economic returns.

After the first four years of participation, the indexed mean sales value shows a greater absolute value than the other two variables. Except for the last year or two, it also shows the greatest rate of increase. By the end of the ten years, the index value for sales was 50 per cent higher than the index of labor earnings and about 60 per cent greater than the index of return to capital and family labor.

The indexed mean return to capital and family labor showed a generally smaller value than the other two variables from year one through five. After the fifth year, the index for this variable was greater than for labor earnings and kept the advantage until the tenth year. Return to capital and family labor increased at an increasing rate after the second year.

It was hypothesized that a comparison among the three measures of economic return to investments in farm management education for farmers in well-organized programs would show much the same form as for all farmers in the study; but the indexed values would be higher for participants in well-organized programs.

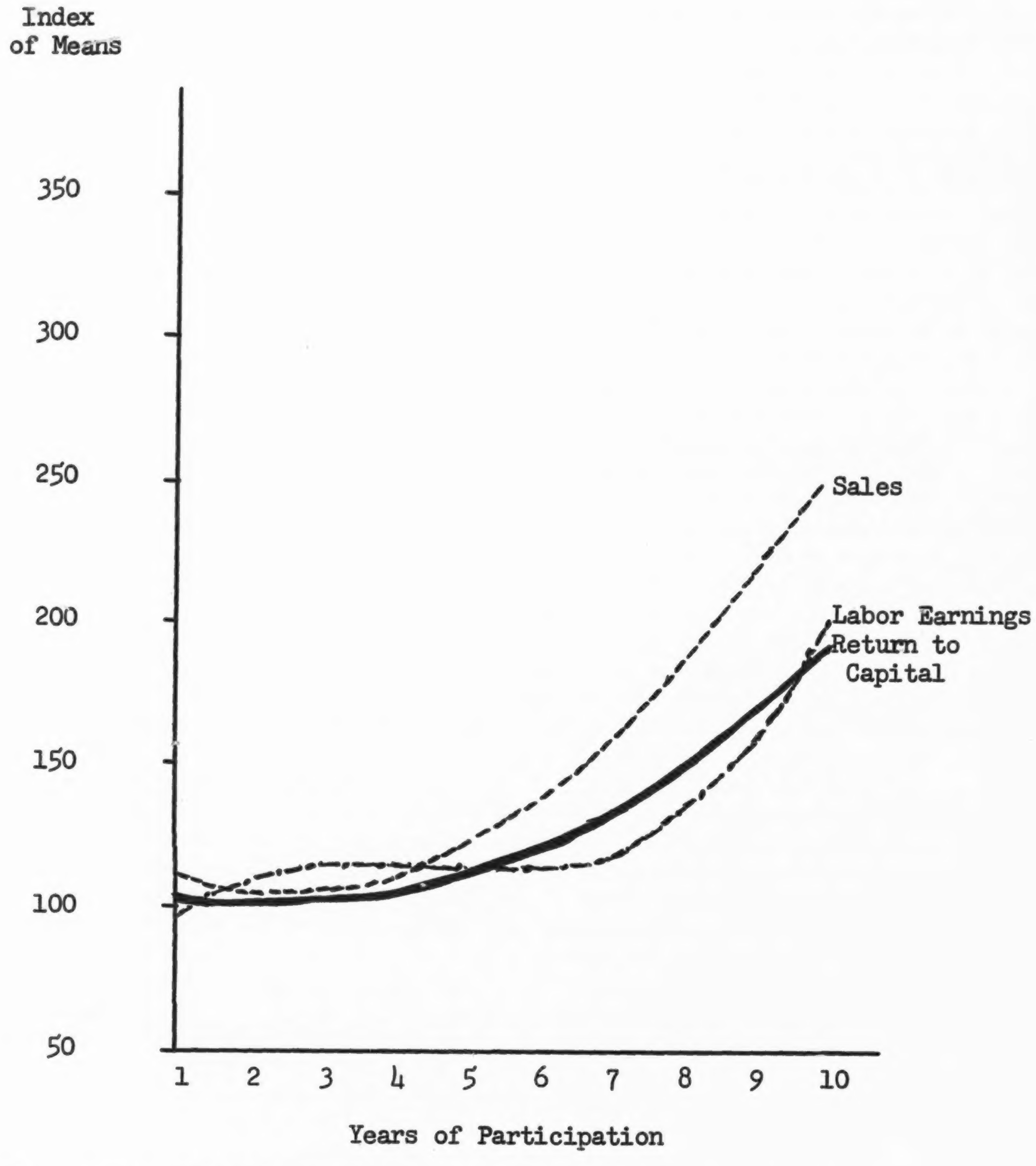

Figure 24. THE RELATIONSHIP OF THE INDEX OF LABOR EARNINGS, TOTAL FARM SALES, AND RETURN TO CAPITAL AND FAMILY LABOR TO ADULT FARM BUSINESS MANAGEMENT EDUCATION[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota, 1959-1965.

Figure 25 is quite similar to Figure 24 except the rates of change are more pronounced for farmers in well-organized programs. All three indicators had indices that climbed from near 100 in the first year to well over 200 by the tenth year. An index for total farm sales of nearly 340 by the tenth year indicated that farmers in well-organized programs who participated for ten years had sales about 3.4 times as great as farmers keeping their first record.

Three distinctly different types of curves were exhibited by the indexed mean values. The return to capital and family labor was plotted in a straight line. The total farm sales showed an increase at an increasing rate for the first three years, then essentially no change for three years, and, finally, in the fifth year started increasing at an accelerating rate. Labor earnings increased during the first three years and then decreased until the seventh year in which it started increasing at a sharply increasing rate.

In both Figures 24 and 25, the increase in values during the first three or four years of participation in the farm business management education program was predominantly in labor earnings and in total farm sales. While sales were increasing rapidly after the fifth or sixth year, labor earnings remained about the same or decreased until the seventh year.

It was hypothesized that farmers with twelve or more years of formal education would have rapid rates of increase in farm earnings in relation to years of participation in farm business management education. Figure 26 illustrates the plot of indexed means of the three measures of economic returns for farmers with twelve or more years of formal education. Although there were several crossovers, in the first five or six years the index values were generally equal. After the sixth year of participation, the rate of increase for sales and labor earnings was gaining much faster than return to capital and family labor. By the eighth year, the indices for sales and labor earnings were well over 350 while the value for return to capital was 225.

The plots of relationships between the measures of economic returns to investments in education and participation in adult farm business management education generally showed increases in returns related to years of participation. Frequently, the graphs showed a slowing in the rate of increase between the fourth and sixth years of participation. Likewise, most graphs also show very rapid increases in response to the educational investments following the sixth and subsequent years of instruction. These relationships suggest that advocates of a very limited farm business management education program are underestimating the real values that can accrue from continuous, intensive, and long-term educational programs in farm business management.

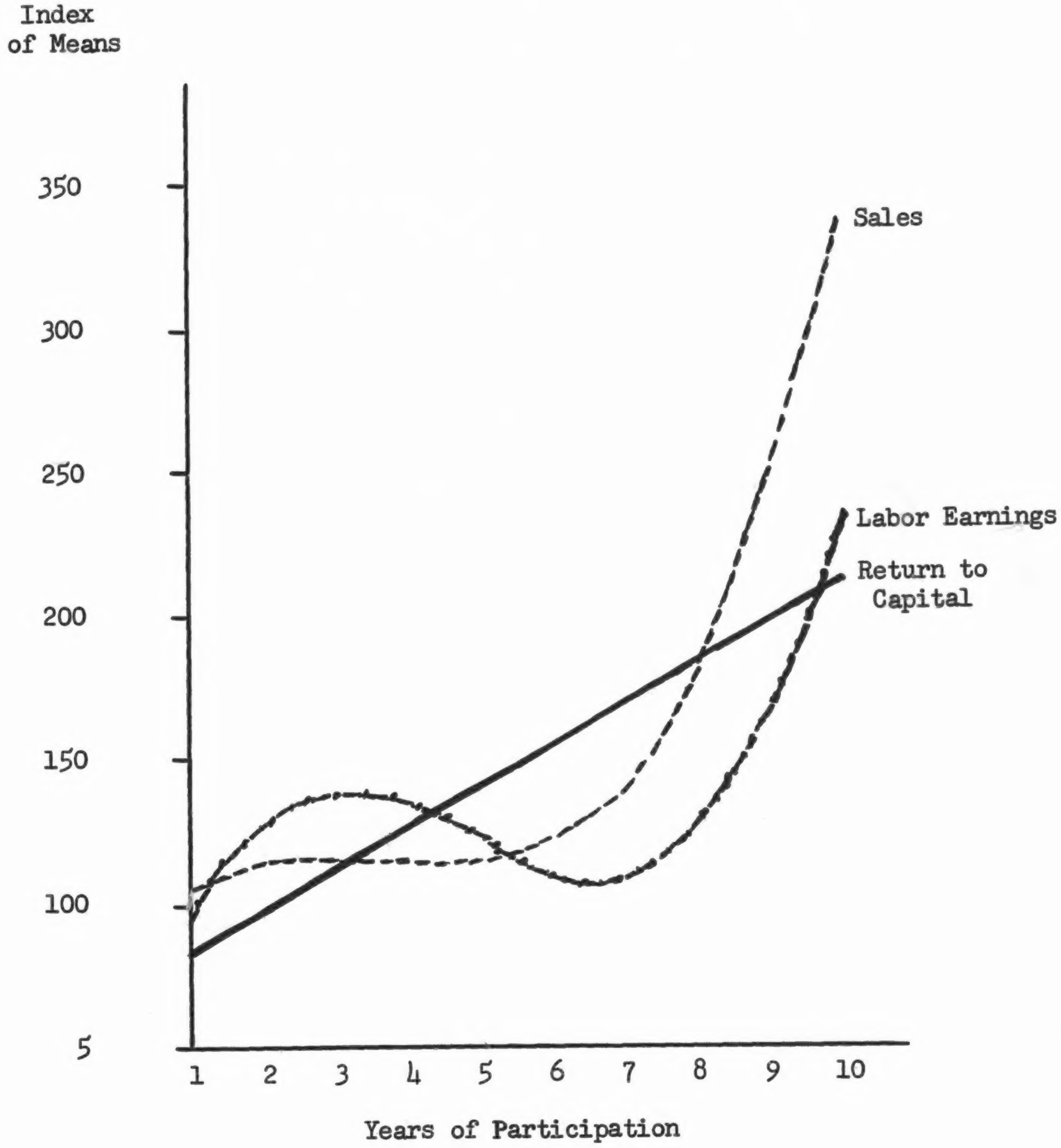

Figure 25. THE RELATIONSHIP OF THE INDEX OF LABOR EARNINGS, TOTAL FARM SALES, AND RETURN TO CAPITAL AND FAMILY LABOR TO ADULT FARM BUSINESS MANAGEMENT EDUCATION - WELL-ORGANIZED PROGRAMS[a]

[a] Based upon all farmers enrolled in well-organized programs of farm business management education in Minnesota, 1959-1965.

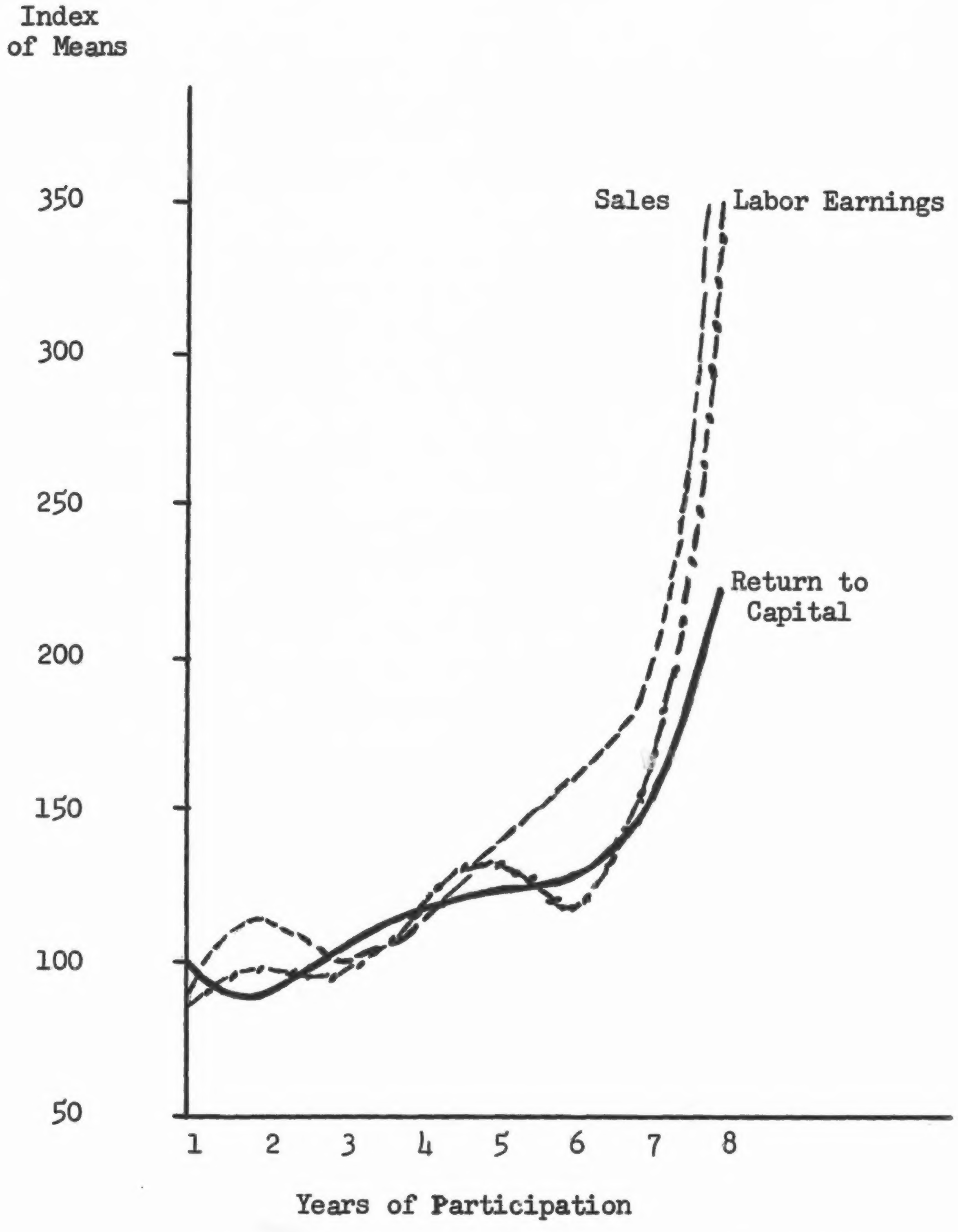

Figure 26. THE RELATIONSHIP OF THE INDEX OF LABOR EARNINGS, TOTAL FARM SALES, AND RETURN TO CAPITAL TO ADULT FARM BUSINESS MANAGEMENT EDUCATION - TWELVE OR MORE YEARS OF SCHOOL[a]

[a] Based upon all farmers enrolled in farm business management education in Minnesota who completed twelve or more years of formal education, 1959-1965.

CHAPTER V

APPLICATION OF BENEFIT-COST ANALYSIS

Presentation of a Model

Davie indicated benefit-cost analysis had merit in the evaluation of vocational education programs. As pointed out in the review of literature, he was concerned with the difficulty of determining future income attributable to the educational program. He suggested two procedures for isolation of additional income: (1) a simple experimental and control group analysis and (2) the development of a formal model to predict the additional income that accrues as a result of instruction.[1]

Various polynomial equations for estimating income from educational inputs were developed as part of this study. This information has been utilized in the benefit-cost procedures which follow.

Davie presented a model for benefit-cost analysis to which the empirical data from this study can be applied. He suggested the model:[2]

$$B_j = \frac{\sum_{t=1}^{n} \frac{R_{tj}}{(1+i_j)^t}}{O_j + C_j}$$

where:

R_{tj} = additional income net of taxes in year "t" expected by individual "j" to accrue as a result of participating in a program of vocational education.

i_j = rate of interest used by individual "j" to discount expected future additional income.

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[1] Davie, Bruce F. "Using Benefit-Cost Analysis in Planning and Evaluating Vocational Education," p. 9.

[2] *Ibid.* p. 16.

O_j = opportunity costs as seen by individual "j".

C_j = direct costs of program borne by individual "j".

n = years during which benefits are expected to accrue.

Calculating Benefits

Prediction equations based upon the farm business records of farmers in well-organized management education programs provided realistic estimates of changes in income associated with measured inputs of education. The labor earnings index for respective record analysis years was multiplied by $3,000 to establish the estimated monetary returns for each year. Base earnings of $3,000 was selected because it was approximately equal to the average labor earnings for first-year records examined in this study.

Income tax adjustments were made utilizing the accrual method. Because the labor earnings includes calculation of some non-cash expenses such as interest on farm capital and wages of unpaid family labor, $1,900[3] was added to the calculated labor earnings for purposes of computing the tax adjustment. Tax rates were adjusted for five dependents since the average family size for all persons analyzing a record for the first time was 5.12.

No benefit to instruction was assigned for the first year. Farm business record analysis was considered essential to permit sound economic planning. Benefits that may have accrued to the farm family during their initial enrollment year were not thought to be unique to farm management instruction and were, thus, not considered. This assumption made the benefit-cost ratio estimate more powerful since it provided a conservative estimate of the total returns to instruction. Cvancara's[4] study indicated that the farmer could expect returns to instruction during the initial enrollment year even though the farm business record analysis was not yet available.

The rate of interest used to discount benefits to the individual was 7 per cent. While Davie suggested a 5 to 6 per cent rate, current conditions indicate a higher rate was justified in this example.

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[3] Equivalent to the mean expenditure reported for unpaid family labor and interest on owned farm capital.

[4] Cvancara, "Input-Output Relationships Among Selected Intellectual Investments in Agriculture," p. 79.

Table 29 shows, in tabular form, the discounted benefits that accrue to a farm family from farm business management education. The total benefits, discounted to show the present value of future costs, were $3,562 for a farm family enrolled for a period of eight years. Benefits are based upon the relationship between income and educational investment shown in Figure 20 (Page 104).

Calculating Costs

Individual or private costs are of two kinds: direct and opportunity. The opportunity costs are based upon the approximate value of the farm operator's labor were he to engage in other productive work rather than participate in the educational program. Study data show this value to be about two dollars per hour on more productive farms. Opportunity costs occur both during the normal working day and during the evening hours. Annual reports from adult farm business management education instructors of well-organized programs showed that a farmer enrolled in one of the first three years of instruction was expected to participate in twelve farm visits of two hours each, three group meetings of two hours duration, and utilize about eight hours keeping the additional, accurate farm business data needed for business analysis. Record keeping time was charged at the daytime opportunity cost rate.

In addition, he was expected to attend at least ten classes held during the evening hours. The opportunity cost rate for the evening hours was reduced to one half the normal working rate since leisure time rather than work time was forfeited by program participation.

Table 30 shows the distribution of opportunity costs for an eight-year period. The opportunity costs for the last five years were reduced to reflect the normal procedure followed in the educational plan. It was assumed that farmers enrolled during this period received six farm visits, utilized eight hours keeping additional farm records, and attended a minimum of six evening class sessions.

The direct costs of program participation included twenty-five dollars for farm business record analysis, three dollars for miscellaneous purchases and three dollars transportation expense for each class attended. An estimated direct cost of sixty-four dollars for each of the first three years dropped to forty-six dollars during the last five years due to a reduction in the number of classes attended. Estimated costs are discounted using the same rate of interest and procedure as outlined for program benefits. A tabular presentation of cost estimates is presented in Table 30.

Unlike the situation presented in Davies' benefit-cost model, costs occurred in all years in which benefits accrued.

Table 29. ADJUSTED MARGINAL LABOR EARNINGS FOR INDIVIDUALS ENROLLED IN WELL-ORGANIZED FARM BUSINESS MANAGEMENT EDUCATION PROGRAMS

a. Record Year	b. Labor[a/] Earnings Index	c. Monetary Value Using $3,000 Labor Earnings Base	d. Marginal Return Over Base Year	e. Marginal[b/] Return After Tax Adjust	f. Discounted Marginal Benefit
1	.97	$2,910	$ ----	$ ----	$ ----
2	1.30	3,900	990	807	704
3	1.40	4,200	1,290	1,050	856
4	1.35	4,050	1,140	927	707
5	1.23	3,690	780	636	453
6	1.12	3,360	450	368	245
7	1.10	3,300	390	320	199
8	1.25	3,750	840	684	398
Total	----	----	$5,880	$4,792	$3,562

[a/] Based upon polynomial fit curve shown in Figure 20, p. 104.

[b/] Tax adjustments based upon 1967 Internal Revenue instructions for filing individual tax returns with allowance for five dependents.

Table 30. PRIVATE COSTS OF EDUCATION FOR INDIVIDUALS ENROLLED IN WELL-ORGANIZED FARM MANAGEMENT EDUCATION PROGRAMS

a. Record Year	b. Daytime Opportunity Costs	c. Nighttime Opportunity Costs	d. Direct Costs	e. Total Costs	f. Discounted Costs
1	76	20	64	160	$150
2	76	20	64	160	140
3	76	20	64	160	131
4	40	12	46	98	75
5	40	12	46	98	70
6	40	12	46	98	65
7	40	12	46	98	61
8	40	12	46	98	57
		Total Discounted Costs			$849

A modification of the benefit-cost model which allows for the continued accrual of costs was made. The principle of discounting is applied to future costs as well as to benefits.

$$B_j = \frac{\sum_{t=1}^{n} \frac{R_{tj}}{(1+i)^t}}{\sum_{t=1}^{K} \frac{O_{jt}}{(1+i)^t} + \sum_{t=1}^{K} \frac{C_{jt}}{(1+i)^t}}$$

where:

R_{tj} = additional income net of taxes in year "t" expected by individuals to accrue as a result of participation in vocational education.

i = rate of interest used by individuals to discount future benefits and costs.

O_{jt} = opportunity cost in year "t" borne by individual "j".

C_{jt} = direct cost in year "t" borne by individual "j".

n = number of years over which benefits accrue.

k = number of years over which costs accrue.

Benefit-Cost Ratio

Benefit-cost ratio is found by dividing the present value of future benefits (Table 29 - total discounted benefits) by the present value of future costs (Table 30 - total discounted costs). The benefit-cost ratio derived from the data in this study was 4.20.

$$\frac{\text{Discounted Benefits} = \$3,562}{\text{Discounted Costs} \quad = \quad 849} = 4.20 \text{ (Benefit-Cost Ratio)}$$

For each dollar the farm operator invested in the educational program as direct out-of-pocket costs and opportunity cost of work time or leisure time foregone, he received a return of $4.20.

The Model for Estimating the Societal Benefit-Cost Ratio

The problem of estimating the benefit-cost ratio for society is much more complex than for the individual. All costs must be accounted for; thus, while the individual could be content to account only for those costs which directly relate to his participation, society must bear other non-direct costs of providing the instruction.

Davie presented the following model for estimating the societal benefit-cost ratio:

$$\bar{B} = \frac{\sum_{j=1}^{m}\sum_{t=1}^{n}\frac{\bar{R}_{tj}}{(1+\bar{i})^{t}}}{\sum_{j=1}^{m}\bar{O}_{j} + \sum_{j=1}^{n}\bar{C}_{j} + \bar{C}_{t=0} + a_{\bar{i}p}K_{o}}$$

In this model -

$\bar{R}_{tj}$ = benefits to individual "j" that occur in time "t".

m = total number of individuals to whom benefits accrue.

n = years over which benefits are calculated.

$\bar{O}_j$ = opportunity costs for individuals enrolled computed at society's rate.

$\bar{C}_j$ = direct costs incurred by individuals enrolled.

$\bar{C}_t$ = direct costs to society during training.

$A_{\bar{i}p}$ = annuity rate whose present value is 1, for interest rate $\bar{i}$ and number of years "p".

K_o = society's capital costs.

Davie assumed in this model that all opportunity and direct costs were incurred during the initial training year. He makes further assumptions that the program results in annual graduation of a specified number of students.

Evaluating the benefits that accrue to society as a result of farm management education poses two fomidable problems. The educational program does not terminate at the close of a single year and, thus, incurs costs over a longer period of time. Likewise, students do not enroll in mass nor graduate in mass but rather represent the entire continuum from those enrolled for the first time to those enrolled for the eighth or more year.

Benefits could be examined based upon a variety of assumptions. To simplify the calculation of benefit-cost ratios, it could be assumed that a number of students sufficient to constitute full employment for the instructor enrolled at one time and remained continuously enrolled for eight or more years with no drop-outs.

An enrollment pattern which placed an equal number of persons in each analysis year class could also be used in calculating benefits. Benefit-cost ratios would be calculated over the time span equivalent to the beginning class completing the course of instruction.

For illustration of the societal benefit-cost ratio for farm management instruction, it was more realistic to follow an enrollment pattern representative of well-organized adult farm management programs. A farm business management program would normally enroll about fifty farm families. It was assumed that members of the class had from zero to eight years of tenure but that distribution in each of the attendance categories was subject to periodic drop-outs. Class enrollment was assumed to be distributed according to the following scheme (Table 31). Each year the class would include ten new farmer cooperators to replace those who dropped out or were enrolled in the more advanced groups.

Table 31. TYPICAL TENURE DISTRIBUTION FOR WELL-ORGANIZED FARM BUSINESS MANAGEMENT EDUCATION PROGRAMS

Years Enrolled		Number Enrolled
1		10
2		9
3		9
4		7
5		5
6		4
7		4
8		3
	Total	51

Davie's benefit-cost model for society was revised to accommodate the organization usually found in farm business management programs. Modification of the model permits costs to accrue over an unlimited period of time and subjects such costs to the same discounting procedure used for benefits. The revised model is presented below:

$$\bar{B} = \frac{\sum_{t=1}^{n} \left(\frac{\sum_{j=1}^{m} \bar{R}_j}{(1+\bar{i})^t} \right)}{\sum_{t=1}^{K} \left(\frac{\sum_{j=1}^{m} \bar{O}_j}{(1+\bar{i})^t} \right) + \sum_{t=1}^{K} \left(\frac{\sum_{j=1}^{m} C_j}{(1+\bar{i})^t} \right) + \sum_{t=1}^{K} \left(\frac{\bar{C}_{t=1}}{(1+\bar{i})^t} \right) + \sum_{t=1}^{K} a_{\bar{i}p} K_0}$$

where:

$\bar{B}$ = benefit-cost ratio to society.

$\bar{R}_j$ = marginal return to individual "j" expected to accrue as a result of participation in a program of vocational education for year t = 1.

$\bar{i}$ = interest rate used by society to discount future benefits and future costs.

$\bar{O}_j$ = opportunity costs for individual "j" as seen by society.

C_j = direct costs of the program borne by the individual.

$\bar{C}_{t=1}$ = operating costs of the program borne by society in year t = 1; assumed equal in all years.

a_{ip} = annuity whose present value is 1 for interest rate $\bar{i}$ and number of years "p".

K_o = capital costs of a program borne by society.

m = number of individuals enrolled.

n = number of years over which benefits are accrued.

k = number of years over which costs are accrued.

Estimates of benefits were derived from marginal labor earnings reported in Table 29 based upon the before-tax marginal returns reported for individuals distributed as suggested in Table 31. Since society benefits from tax revenue, taxes were not subtracted from marginal earnings in calculating benefits. Table 32 shows the calculation of marginal benefits for a typical farm business management program for a single year. These benefits for a single year were subjected to the discounting procedure to determine the present value of all benefits over an eight-year period. The sum of these discounted benefits was $247,411.

Cost estimates were derived from several sources. Opportunity costs for individuals were judged to be the same as reported for individual benefit-cost analysis. While some writers value opportunity costs for society at a different rate than for individuals, the authors chose to make no differentiation between the basis for calculating these costs. Total discounted opportunity costs were $25,202.

Direct program costs borne by individuals were not different than previously reported. Annual direct program costs are the sum of direct costs for the fifty-one families enrolled. The present value of these costs for eight years was $18,422.

Society costs for program operation were based upon the data supplied by the Agricultural Education Section of the Vocational Division, Minnesota State Department of Education, and best estimates of other operating expenses. Direct society costs for program operation are presented in Table 33. Annual program costs for the community are estimated at $11,537.

Table 32. COMMUNITY BENEFITS FROM A FARM BUSINESS MANAGEMENT PROGRAM FOR FIFTY-ONE FAMILIES

Years Enrolled	Number of Farmers	Marginal Labor Earnings per Farmer	Total Marginal Labor Earnings
1	10	----	----
2	9	990	8,910
3	9	1,290	11,610
4	7	1,140	7,980
5	5	780	3,900
6	4	450	1,800
7	4	390	1,560
8	3	840	2,520
Totals	51		38,280

Table 33. OPERATING COSTS FOR A FARM BUSINESS MANAGEMENT EDUCATION PROGRAM - FULL-TIME ADULT INSTRUCTOR

Item	Amount
Salary of Instructor (1966 August)	$ 9,378
Direct Expense for Mileage	717
Direct Expense for Meals and Lodging	150
Janitorial Service (½ hr. per day for 250 days @ $2/hr.)	250
Secretarial Assistance (1/10 time @ $360/month)	432
Teaching Material, General Office Supply	400
Fuel, Electricity for Evening Class Sessions	150
Telephone (12 months @ $5/month)	60
Total Direct Operating Costs	$11,537

Capital expenses were based upon price quotations of school supply businesses submitted to the State Department of Education during 1966. Capital cost for building construction was estimated at $17.24 per square foot. A majority of the capital expenditures for school construction are more logically charged against other phases of the total educational program. Only those facilities which are for the exclusive use of adult vocational farm management education were charged against the program. Table 34 presents estimates of capital expenditures necessary to implement and maintain a farm business management education program.

Table 34. ESTIMATED CAPITAL OUTLAY FOR ESTABLISHMENT OF A FARM BUSINESS MANAGEMENT EDUCATION PROGRAM

Item		Estimated Cost
Office 8' x 10' @ $17.24/sq. ft.		$7,586
Conference Room 12' x 15' @ $17.24/sq. ft.		
Office Equipment		
Desk & Chair	$176	
Filing Cabinets	204	
Typewriter	200	
Calculator	600	
Portable Adding Machine	100	
Total - Office Equipment		1,280
Total Capital Outlay		$8,866
Yearly Cost - $711.41		

Capital costs are distributed over twenty years to reflect depreciation allowance and interest on investment. An annuity rate of .08024% was adequate to provide for a capital life span of twenty years with a 5% interest rate.

The decision whether or not to support a farm management education program should be dependent upon consideration of the economic benefit-cost ratio and other society or social benefits which deny numeric measurement.

The total discounted benefit for eight years of operation of a farm business management education program was $247,411. Total costs were also discounted for eight years. The sum of individual opportunity costs ($25,202), individual direct costs ($18,422), community direct operating costs ($74,565), and capital outlay ($5,688) was $123,877. The benefit-cost ratio is:

$$\frac{\text{Total Benefits to the Community}}{\text{Total Costs to the Community}} = \frac{\$247{,}411}{\$123{,}877} = 1.997$$

For each dollar of total costs for society and individuals, society received $1.99 in benefits when benefits include only labor returns to program participants.

A problem encountered in studying the economic returns for entrepreneurs is to devise an income measure that is comparable to the income measures of other vocational education participants who are wage earners. The benefit-cost analysis for individuals uses measures of farm operators' earnings that are comparable to wages of employees in other businesses. Labor earnings make compensation for capital investment and family labor and, thus, is a good indication of the payment the farm entrepreneur receives for his labor and management ability.

Benefits to society, however, are greater than the residual benefits to the entrepreneur. Society benefits from the total increase in business activity, benefiting equally as much from the farm income spent in the course of production as it does from the residual to entrepreneurial labor and management. Gross farm income can be distributed in a variety of ways: as operating expense, as capital investments in the business, family living, or as savings. Only in the event that income from total farm sales was withdrawn from society (saved in the form of hoarded assets) would society cease to benefit from marginal growth in business activity. Contrary to the wage earner whose monthly salary constitutes his total economic impact on society, the farmers' impact is measured best by total business volume or farm sales.

The marginal relationship between farm sales and participation in farm management education is presented in Table 35. The high R^2 value of this relationship (.721) indicated a high correspondence between sales and education.

With farm sales as the criterion measure, the total discounted benefits for an eight-year period of farm business management instruction would be $1,122,398 for a program enrolling fifty-one farm families. The costs would be the same as reported previously, $123,877.

Table 35. MARGINAL FARM SALES ASSOCIATED WITH ENROLLMENT IN FARM BUSINESS MANAGEMENT EDUCATION

Years Enrolled	Number of Farmers	Marginal Farm Sales per Farm[a]	Total Marginal Farm Sales[b]
1	10	----	$ ----
2	9	2,660	23,940
3	9	3,230	29,070
4	7	2,850	19,950
5	5	2,660	13,300
6	4	3,800	15,200
7	4	7,220	28,880
8	3	14,440	43,320
Totals	51		$173,660

[a] Based upon the statistical estimates of points on the curve in Figure 4, Page 83, and average farm sales reported in first-year record analysis, 1959-1965.

[b] Total discounted benefits for eight years using discounting procedures defined for individual benefits equals $1,122,398.

Using these sums in a benefit-cost comparison gives a benefit-cost ratio of 9.06. For each dollar spent or charged to farm business management education, the community could expect to receive $9.06 in increased business activity.

Summary

Benefit-cost analyses of educational programs have not been commonly made at the micro-economic level. The major detriment to application of the benefit-cost technique to the educational setting has been the determination of marginal economic response to instruction. This study of the investment effects of education on agriculture provided empirical data for application to a variety of theoretical benefit-cost procedures.

The model presented by Davie was selected to illustrate the applicability of this benefit-cost analysis to education. Modification of the model for individuals was necessary to allow for the accrual of recurring costs during the benefit period and discounting of these costs to present values.

In well-organized programs of instruction, a benefit-cost ratio of 4.20 was calculated for individual participants.

Application of benefit-cost procedures in calculating the returns to society was hampered by interpretations of the most appropriate measure of individual return. The measure which best reflected individual returns (labor earnings) was not inclusive of the entire monetary benefit to society. A measure of gross business volume (total farm sales) was suggested as the most representative measure of marginal returns to society.

The societal model of benefit-cost analysis was modified to allow for the accrual of program costs during the entire benefit period. Because interpretation of benefits was most reliable during the first eight years of enrollment, the benefit cost ratio was calculated using that period in which to accumulate costs and benefits. An assumed drop-out rate modified the theoretical membership in each enrollment tenure category and produced an estimated total class membership which was most like that found in established programs. The benefit-cost ratio for well-organized programs of instruction using labor earnings as the measure of societal benefits was 1.997:1. Using total farm sales as the marginal benefit measure resulted in a benefit-cost ratio of 9.06:1.

CHAPTER VI

CONCLUSIONS AND IMPLICATIONS

This study concerns itself with an agricultural instructional program for operating farmers. The instructional program is categorized as adult education. The program itself has been continually expanding and it has been increasingly accepted as a function of adult education and manpower retraining in agriculture. Precise farm record keeping and an analytical approach to management are essential elements of the educational program. They provide both data and criteria of educational investment for the research reported in this report.

The study provides a basis for planning similar educational programs. It also adds an important dimension to the literature on the economics of education. The study includes a benefit-cost analysis of educational inputs to individual farm units and to communities. Contributions of this inquiry to the literature covering educational benefit-cost analysis should be of general interest to the field of education and of special interest to the field of agriculture.

Age and Economic Class

The average age of farm operators as reported in the 1959 and 1964 Minnesota Agricultural Census varied from 44.0 years in economic class II to 48.4 years in economic class IV (1964). There is a significant relationship between age and economic class. In general, except for economic class I, average farm operator's age decreased as farm sales volume, measured by economic class intervals, increased. Farm sales is not a positive function of age. The average age of farmers in economic class I declined from 1959 to 1964 while the average operator age in all other economic classes increased slightly.

Education and Economic Class

There is a significant relationship between the years of schooling completed and farm sales volume as reported by Agricultural Census. Farm operators in economic class IV have only 9.1 years of formal education while those in economic class I had completed 10.5 years of school. This relationship may in part be directly influenced by the age characteristics of farmers in each economic class. Farmers under 35 years of age reported 11.1 years of school completed while those 55-65 years old reported an average educational level of only 8.5 years of school.

Census Versus Study Population

Farmers included in the study differ from the average farmer, as defined in the U. S. Census of Agriculture for Minnesota, in several significant ways.

The sales volume of farmers used in the study is considerably higher than census averages. Only 20 per cent of those enrolling for the first time in 1964 had sales less than $10,000 while 48 per cent of the farmers reported in the Agricultural Census in 1964 had a comparable income level. The adult farm business management program is not directed toward the farm operator with severely limited sales volume. Agricultural educators need to examine the way in which a program in farm business management education can be utilized more effectively with the less affluent and part-time farmers.

Farm operators who participate in the farm business management education program are generally younger than the average farmer as defined by the Census of Agriculture. The average of farm operators who enrolled for the first time in the educational program is about 35 years while the average farm operator in economic classes I through IV, as defined by Census, is about 45 years old. The farm business management education program attracts the younger farm operators.

Farm size of those enrolling in the education program, as measured in acres, is not as large as that recorded for the general farm population. Comparison of first-year participants with all others enrolled in farm business management education in 1964 indicates that farm size does not increase significantly as operators progress in the educational program.

Those who enroll in the farm business management program have completed more years of formal education than farm operators reported in the Census population. Those enrolled for the first time in 1964 whose sales volume placed them in economic class I completed an average of 12.2 years of formal education. The average educational level for all participants in the educational program was more than 11 years of school.

In summary, farm operators enrolled in farm business management education programs in comparison with the average farm operator, as defined by the Agricultural Census, are more likely to be (1) in the top three economic classes, (2) better educated, and (3) significantly younger.

Prediction of Farm Sales - Multiple Regression

Farm sales can be predicted with reasonable accuracy ($R^2 = .49$) with information about farm capital, work units, livestock intensity, index of crop yields, work units per worker, work units on livestock, the total acres of tillable land income from off the farm, and participation in farm business management education programs. Of eleven variables which had a significant correlation with labor earnings, only "work units on crops" did not make a significant contribution to the prediction equation for farm sales. A majority of the variables used in the regression analysis were connected with farm size, business volume, or business efficiency.

Prediction of Labor Earnings - Multiple Regression

Labor earnings cannot be readily predicted by examining the eleven variables used in multiple regression analysis. Only about 20 per cent of the variation in labor earnings was accounted for. On individual farms, the variables which contribute significantly to the prediction of total farm sales do not provide a highly dependable estimate of labor earnings. Some of the important measures of business size fail to contribute significantly to the prediction equation. This failure is an indication that volume and size alone cannot solve problems of low farm income. Improved management must accompany business expansion.

Prediction of Return to Capital and Family Labor - Multiple Regression

The same variables that were significant in the prediction of labor earnings can be used effectively to predict return to capital and family labor.

In all measures of income studied, participation in the farm business management education program made a significant contribution to the regression equations.

Polynomial Regression

As mentioned on Page 76, a procedure employing bivariate polynomial regression was used as the analytical tool to arrive at major conclusions included in this study.

Income (operators' labor earnings, return to capital and family labor and total farm sales) constituted one of the variables in the bivariate relationship. It also served as the dependent variable in the multiple regression analysis which identified the significant independent contributors to variation in income. Important among these was instruction. In this study, instruction varied by number of records analyzed or by years of instruction. The bivariate curvilinear relationship, thus, was between income and instruction with income measured as an index and instruction measured in years.

It should be stressed that the polynomial analysis emphasized instruction given in well-organized situations. In other words, the instructional variable was one emphasizing intensive and programmatic instruction. Not all of the adult education could be regarded as satisfying the definition of this category. The multiple regression analysis included all of the adults who were enrolled in adult management classes. Some curvilinear regression analyses included those who were enrolled for two or more years. But the bivariate polynomial analysis emphasized the intensive, programmatic, well-organized instruction since this instruction offered the best opportunity to achieve an incremental treatment effect and also the best opportunity to achieve a replicable experiment.

Performance Curves

In this study, the calculation of polynomial equations has resulted in what the researchers have described as performance curves. As mentioned in the previous section, these curves are curvilinear descriptions of bivariate distributions of income and instruction.

The performance curves were initially calculated to determine whether there were diminishing marginal returns to the educational input. The possibility of a diminishing marginal return effect was a valid hypothesis since it was partially demonstrated in earlier studies.

The performance curves which were calculated in this study followed a consistent and a dramatic pattern. In the early stages of instruction, income rose sharply. This rise was followed by a slight decline in income during the fourth, fifth, and sixth years of instruction. In the following years (years seven through ten) the income again rose sharply.

The general shape of the performance curves is the consequence of the nature of the instructional input or the treatment variable. During the early stages of instruction, income rises as a result of easily-won gains which follow from simple modifications of practices within current farm organization. In the fourth, fifth, and sixth years of instruction, farm operators are required to make major modifications in their patterns of enterprise organization. During this period, income actually declines. It is a period of instruction, reorganization, and regrouping for subsequent growth. The increases in farm income which follow the fourth, fifth, and sixth years of instruction are those which arise from modifications in organization, the application of new entrepreneurial skill and the introduction of new forms of agricultural technology. These gains are dramatic and significantly related to the instructional input.

The concept of performance curves is enormously useful to education. First, it establishes a significant interdisciplinary relationship between education and economics. It provides a valid set of interrelationships for examining marginal rates of return on educational inputs. Second, it demonstrates and displays an interpretation of the psychological phenomenon of learning curves. The performance curves calculated in this study are, in fact, learning curves whose cycles extend over an eight-year period. The plateau in the learning curves is induced by the nature of instruction and, simultaneously, these plateaus represent diminishing, though temporary, marginal returns to increasingly intensive instruction.

Third, the concept of performance curves may serve as a criterion variable for further research and also for demonstration. The performance curves are representations of an input-output relationship involving education. They will respond to various treatment effects or to variations in educational emphases. Performance curves are available, accordingly, as criterion variables to reflect changes which may occur in curriculum, teacher training, program organizations, instructional intensity, or other variables.

Fourth, the concept of performance curves may now begin to emerge as the beginning stages of a useful theoretical model for occupationally-related instruction. They are relevant, for example, to the well-known but relatively unresearched "diffusion" model in the field of continuing education. The diffusion process is probably represented in the early stages of the performance curves where there are easily-won returns from easily-applied technology. The concept of performance curves adds an understanding of the value of systematic instruction and the usefulness of reference groups in assessing the value of membership in organized instructional groups.

The concept of performance curves also provides a theoretical model and an organized rationale for examining the role of entrepreneurial behavior in educational programs for the self employed and the role of persistence in any instructional program where the learning curve extends over a period as long as five to eight years.

Variation in Performance Curves

In this study, there was a considerable amount of variation in the shape of the calculated performance curves. The amount of formal education possessed by farmers had a large effect, for example, on the shape of the curves. The sample was divided into two groups with one having twelve or more years of formal education and the other having less than twelve years of formal education. The relationship of education to earnings was significant in both groups but the group with more formal education began to achieve a rising income at an earlier stage, and it rose to a higher level as well as at a more rapid rate. This was especially true when operators' labor earnings was used as the measure of income (see Page 85). When return to capital and family labor was used as a measure of the return to the total farm business, the relationship of formal education to income was more erratic (see Page 95). It is not possible to ascertain whether this phenomenon was related in any direct way to the level of formal education. It is entirely possible that this group had more innate ability or other qualities which allowed formal education, like higher levels of income, to be a consequence rather than a cause.

The shape of the performance curves was also considerably affected by the amount of capital which operators had at the beginning of the instructional program. Those who began with a higher level of farm capital made more rapid progress and achieved a higher level of income during the instructional cycle.

An interesting aspect of the study was the fact that the average beginning income level of the group included in the study was not much different from the income level reported in the census for comparable years. The beginning income level was slightly more than $3,000.

Benefit-Cost Analysis - Participants

To be economically sound, the benefits of an educational program must exceed the costs. Benefits may be either economic or the more intangible social benefits of which educators often speak. The farm business management education program returned a total economic marginal benefit of $5,880 in an eight-year period for the average farm operator who participated. This marginal return, discounted to $3,562 to reflect present value, exceeded discounted costs by a ratio of 4.19 to 1. Costs included all opportunity and direct costs that the farm operator accrued as a result of program participation.

Community Benefit-Cost Analysis

Communities can measure benefits either in the total net income returned to program participants or in a measure of increased business activity, such as total farm sales, generated by the farm business management education program. The benefit-cost analysis for communities must account for all program costs. When benefits are measured in increased labor earnings for program participants and when costs include opportunity and direct costs for all participants, program operation costs borne by the community, and an allowance for capital investment in school buildings and equipment, the total community benefits exceed total program costs by approximately two to one.

When benefits are measured in marginal farm sales (a measure of increased business activity), the total community benefits exceed total costs by a ratio of 9:1.

Any investment with a benefit-cost ratio similar to that shown for education in farm business management is a valuable economic asset for a community. As community action groups, boards of education, chambers of commerce, and others seek ways to fight poverty and to build affluence in rural communities or to protect local economies, farm business management education should be among the high priority alternatives. Rural America is highly dependent upon a vigorous, productive, agriculture industry. A strong, dynamic and profitable farm business is a community's most valuable asset. This study assists in establishing a rationale for such programs and, at the same time, it describes an educational model for making the decisions which lend to efficiency in program growth.

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APPENDIX A

DATA COLLECTION INSTRUMENT - PROJECT 427-65

This is record: 1_2_3_4_5_6_7_8_9_10_11_12_13_14+_

Code__________

Name__________ Address__________

Farm Management School or Unit (F.A. 51)__________

Record for Fiscal Year: 1959__'60__'61__'62__'63__'64__'65__

F.A. 51

Year started farming__Operator's Age__Tenure: Owner__Renter__Partner__

F.A. 20

Line: End of Year

8 Total Productive Livestock: Whole Farm__
10 Crops, Seed, Feed " " __
15 Machinery and Equipment " " __
17 Land " " __
18 Buildings, Fences " " __
19 Total Farm Capital " " __
19 Total Farm Capital: Operator's Share __
31 Total Assets " " __
45 Total Liabilities " " __
47 Net Worth " " __
48 Change in Net Worth " " __

Efficiency Factors

a. Labor Earnings __
b. Index Crop Yld. __
c. % High Ret. Cps. __
d. Feed Index __
e. Liv. Unit/100 A. __
f. Work Units __
g. Work Units __
h. P.M. Bld. Exp./WU__

Animal	Animal Units
Dairy Cows	____
Other Dairy	____
Beef Breeding Herd	____
Feeder Cattle	____
Hogs	____
Sheep-Farm Flock	____
Sheep-Feeders	____
Turkeys	____
Chickens	____

l. Work Unit-Crops __
m. Work Unit-Lvstk. __
p. Work Unit-Other __
t. Total Power/WU __
u. Crop Mach./WU __
v. Lvstk. Eqpt./WU __
x. Bldg. Exp./WU __
z. Factors Ave++ __

F.A. 21

Income from work off farm-operator's share__

Line:

1 Total Farm Sales: Operator's Share __
2 Increase in Farm Capital " " __
3 Family Living from Farm " " __
4 Total Farm Receipts " " __
5 Total Cash Operating Exp." " __
10 Total Farm Purchases " " __
11 Decrease in Farm Capital " " __
12 Interest on Capital " " __
13 Unpaid Family Labor " " __
14 Board Furnished Hired Lab" " __
15 Total Farm Expenses " " __
16 Labor Earnings " " __
17 Return to Capital & Fam. " " __
Number of Persons in Family __
Adult Equivalents __
Income from Outside Investments __
Income from Sale of Investments __
Other Personal Income __

F.A. 22

Line:

17 Ret. over Feed/Lvstk__
18 Crop, Seed, Feed __
45 Real Estate Taxes __
46 Personal Prop. Tax __

F.A. 23

Total Tillable Land (G)__
Total Land in Farm (N)__
Rented (N) __
Owned (N) __

Table 36. MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FROM 1959-1965

	Years of Participation							
Year	1	2	3	4	5	6.5	9	12.5
1959	$15,650 (106)a/	17,715 (77)	15,999 (50)	15,188 (37)	17,896 (31)	35,012 (12)		
1960	$16,298 (90)	18,655 (68)	18,816 (43)	13,678 (30)	31,901 (32)	26,126 (32)	141,633 (4)	
1961	$16,102 (94)	20,215 (60)	20,677 (56)	19,534 (38)	16,044 (26)	20,939 (50)	52,425 (6)	
1962	$20,701 (137)	18,903 (71)	22,703 (43)	22,231 (47)	18,000 (34)	18,508 (47)	41,575 (26)	
1963	$18,996 (232)	29,814 (102)	19,738 (62)	20,661 (43)	18,930 (44)	17,380 (50)	21,097 (47)	96,146 (2)
1964	$21,789 (221)	21,461 (166)	23,614 (85)	22,770 (55)	23,224 (37)	20,005 (59)	31,237 (58)	69,084 (3)
1965	$19,221 (327)	25,655 (166)	26,407 (130)	25,043 (80)	24,571 (48)	26,955 (65)	24,073 (60)	59,004 (20)
Mean	$18,394	21,774	21,136	19,872	22,652	23,561	52,006	74,744
Wgtd. Mean	$19,041	22,605	22,190	20,920	21,732	22,141	30,894	63,185

a/ The numbers in parentheses indicate the number of cases included in each mean.

Equation for predicting mean total farm sales based upon this Table: $Y = 22803.16406 + (-2764.22363 \times X) + (511.93921 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .497$.

Table 37. INDEXED MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FROM 1959-1965

	Years of Participation							
Year	1	2	3	4	5	6.5	9	12.5
1959	100 (106)a/	113 (77)	102 (50)	97 (37)	114 (31)	224 (12)		
1960	100 (90)	114 (68)	115 (43)	84 (30)	196 (32)	160 (32)	869 (4)	
1961	100 (94)	125 (60)	128 (56)	121 (38)	100 (26)	130 (50)	326 (6)	
1962	100 (137)	91 (71)	110 (43)	108 (47)	87 (34)	89 (47)	201 (26)	
1963	100 (232)	157 (102)	104 (62)	109 (43)	100 (44)	91 (50)	112 (47)	506 (2)
1964	100 (221)	99 (166)	108 (85)	105 (55)	107 (37)	92 (59)	143 (58)	317 (3)
1965	100 (327)	133 (166)	137 (130)	130 (80)	128 (48)	140 (65)	125 (60)	307 (20)
Mean	100	118	115	108	123	128	283	406
Wgtd. Mean	100	119	117	110	114	116	162	332

a/ The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean total farm sales index based upon this Table: $Y = 1.21807 + (-0.13209 \times X) + (0.02615 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .469$.

Table 38. MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS ENROLLED IN WELL-ORGANIZED ADULT PROGRAMS

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	$14,255 (45)a/	12,153 (18)	26,292 (7)	14,283 (12)	15,997 (11)	92,993 (3)		
1960	$18,862 (36)	17,121 (31)	13,887 (17)	12,719 (4)	18,179 (11)	38,376 (12)	270,502 (2)	
1961	$13,372 (43)	22,536 (30)	20,850 (27)	17,054 (12)	13,812 (4)	21,568 (20)	122,955 (2)	
1962	$19,991 (59)	16,817 (32)	25,907 (27)	26,012 (21)	19,107 (11)	18,674 (15)	53,482 (11)	
1963	$16,351 (88)	37,771 (48)	17,748 (29)	21,815 (26)	24,558 (18)	17,515 (16)	21,840 (17)	
1964	$25,341 (92)	17,296 (73)	24,285 (45)	21,336 (25)	25,690 (23)	25,463 (25)	47,947 (19)	92,563 (2)
1965	$19,650 (124)	28,818 (86)	26,508 (62)	25,366 (44)	22,975 (21)	30,580 (37)	22,890 (22)	91,643 (10)
Mean	$18,260	21,787	22,211	19,798	20,045	35,024	89,936	92,103
Wgtd. Mean	$19,059	23,640	23,108	22,152	21,785	27,338	43,302	91,797

a/ The numbers in parentheses indicate the number of cases included in each mean.

Equation for predicting mean total farm sales based upon this Table: $Y = 14887.80078 + (5632.16016 \times X) + (-1678.70532 \times X^2) + (164.04945 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .721$.

Table 39. INDEXED MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS ENROLLED IN WELL-ORGANIZED ADULT PROGRAMS

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (45)[a]	85 (18)	184 (7)	100 (12)	112 (11)	652 (3)		
1960	100 (36)	91 (31)	74 (17)	67 (4)	96 (11)	203 (12)	1,434 (2)	
1961	100 (43)	169 (30)	156 (27)	128 (12)	103 (4)	161 (20)	919 (2)	
1962	100 (59)	84 (32)	130 (27)	130 (21)	96 (11)	93 (15)	268 (11)	
1963	100 (88)	231 (48)	109 (29)	133 (26)	150 (18)	107 (16)	134 (17)	
1964	100 (92)	68 (73)	96 (45)	84 (25)	101 (23)	100 (25)	189 (19)	365 (2)
1965	100 (124)	147 (86)	135 (62)	129 (44)	117 (21)	156 (37)	116 (22)	466 (10)
Mean	100	119	122	108	110	192	493	504
Wgtd. Mean	100	124	121	116	114	143	227	482

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean total farm sales index based upon this Table: $Y = 0.72753 + (0.41834 \times X) + (-0.11547 \times X^2) + (0.00999 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .679$.

Table 40. INDEXED MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS WITH LESS THAN TWELVE YEARS OF FORMAL EDUCATION

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (26)[a]	117 (9)	80 (13)	70 (5)	126 (7)			
1960	100 (12)	67 (18)	84 (6)	52 (6)	59 (5)	70 (7)		
1961	100 (29)	145 (11)	166 (10)	165 (5)	108 (6)	119 (9)		
1962	100 (28)	80 (21)	139 (7)	137 (10)	109 (6)	102 (10)	265 (7)	
1963	100 (48)	128 (26)	97 (22)	135 (7)	91 (9)	90 (10)	99 (9)	
1964	100 (40)	101 (30)	91 (20)	96 (20)	126 (7)	90 (13)	85 (12)	
1965	100 (96)	96 (35)	166 (20)	119 (19)	98 (18)	124 (14)	87 (11)	229 (6)
Mean	100	105	118	111	95	99	134	229
Wgtd. Mean	100	102	117	111	102	101	121	229

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed mean total farm sales based upon this Table: $Y = 41.13 + (74.55 \times X) + (-22.58 \times X^2) + (1.99 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .24$.

Table 41. INDEXED MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS WITH TWELVE OR MORE YEARS OF FORMAL EDUCATION

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100	107	139	94	95	263		
	(47)[a]	(34)	(21)	(19)	(16)	(5)		
1960	100	120	111	109	326	215		
	(33)	(32)	(25)	(16)	(14)	(15)		
1961	100	111	105	109	110	124		
	(44)	(26)	(29)	(22)	(13)	(22)		
1962	100	95	106	90	83	93	239	
	(81)	(38)	(23)	(24)	(19)	(21)	(12)	
1963	100	179	112	111	96	94	108	
	(138)	(60)	(29)	(26)	(25)	(30)	(23)	
1964	100	99	105	121	114	93	182	
	(128)	(102)	(52)	(25)	(23)	(35)	(32)	
1965	100	146	135	144	164	149	139	413
	(163)	(92)	(84)	(48)	(21)	(41)	(34)	(10)
Mean	100	122	116	111	141	147	167	413
Wgtd. Mean	100	126	119	116	134	127	157	413

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed mean total farm sales based upon this Table: $Y = -137.83 + (378.14 \times X) + (-181.86 \times X^2) + (26.192 \times X^3) + (2.8964 \times X^4) + (-1.0161 \times X^5) + (.065694 \times X^6)$.

The strength of the relationship implied in the prediction equation: $R^2 = 99.8$.

Table 42. MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FOR TWO OR MORE YEARS FROM 1959-1965

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	$15,630 (68)[a/]	17,715 (77)	15,999 (50)	15,188 (37)	17,896 (31)	35,012 (12)		
1960	$17,856 (60)	18,655 (68)	18,890 (42)	13,678 (30)	31,901 (32)	26,126 (32)	183,894 (3)	
1961	$17,202 (72)	20,215 (60)	20,677 (56)	19,534 (38)	16,044 (26)	20,939 (50)	52,425 (6)	
1962	$21,837 (98)	18,903 (71)	22,703 (43)	22,231 (47)	18,000 (34)	18,508 (47)	41,575 (26)	
1963	$19,235 (165)	30,389 (99)	19,738 (62)	20,661 (43)	18,930 (44)	17,380 (50)	21,097 (47)	96,146 (2)
1964	$22,779 (162)	21,582 (164)	23,708 (84)	22,770 (55)	23,224 (37)	20,005 (59)	31,237 (58)	69,084 (3)
1965[b/]		$25,655 (166)	26,408 (130)	25,043 (80)	24,571 (48)	26,955 (65)	24,073 (60)	59,004 (20)
Mean	$19,090	21,873	21,160	19,872	21,510	23,561	59,050	74,744
Wgtd. Mean	$19,803	22,687	22,218	20,920	21,732	22,141	30,974	63,185

[a/] The numbers in parentheses indicate the number of cases included in each mean.

[b/] The records for 1965 were not used to compute the prediction equation.

Equation for predicting mean total farm sales based upon this Table: $Y = 24101.77734 + (-3714.68433 \times X) + (637.03638 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .411$.

Table 43. INDEXED MEAN TOTAL FARM SALES BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FOR TWO OR MORE YEARS FROM 1959-1965

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (68)[a]	113 (77)	102 (50)	97 (37)	115 (31)	324 (12)		
1960	100 (60)	104 (68)	106 (42)	77 (30)	179 (32)	146 (32)	1,030 (3)	
1961	100 (72)	118 (60)	120 (56)	114 (38)	93 (26)	122 (50)	305 (6)	
1962	100 (98)	87 (71)	104 (43)	102 (47)	82 (34)	85 (47)	190 (26)	
1963	100 (165)	158 (99)	103 (62)	107 (43)	98 (44)	90 (50)	110 (47)	500 (2)
1964	100 (162)	95 (164)	104 (84)	100 (55)	102 (37)	88 (59)	137 (58)	303 (3)
1965[b]								
Mean	100	115	111	104	113	123	309	392
Wgtd. Mean	100	115	112	106	110	112	156	319

[a] The numbers in parentheses indicate the number of cases included in each mean index.

[b] The records for 1965 were not used to compute the prediction equation.

Equation for predicting mean total farm sales index based upon this Table: $Y = 1.18077 + (-0.13686 \times X) + (0.02770 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .242$.

Table 44. MEAN RETURN TO CAPITAL AND FAMILY LABOR BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FROM 1959-1965

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	$3,420 (106)a/	3,442 (75)	3,619 (52)	3,586 (38)	3,941 (30)	5,745 (11)		
1960	$5,229 (91)	4,111 (68)	4,800 (47)	4,391 (32)	4,553 (33)	6,808 (30)	4,230 (3)	
1961	$4,762 (92)	6,376 (61)	6,011 (57)	4,700 (37)	4,814 (28)	6,228 (50)	6,159 (7)	
1962	$4,823 (137)	4,906 (69)	5,700 (43)	5,569 (48)	4,544 (34)	4,948 (48)	4,064 (26)	
1963	$5,901 (231)	6,056 (102)	5,992 (60)	6,772 (42)	5,657 (45)	5,229 (51)	16,783 (47)	1,228 (2)
1964	$5,496 (222)	4,425 (165)	4,072 (85)	4,850 (54)	5,967 (36)	5,171 (60)	5,065 (58)	5,933 (3)
1965	$5,807 (329)	7,519 (169)	8,562 (129)	7,150 (79)	8,415 (46)	10,540 (65)	9,248 (59)	12,498 (20)
Mean	$5,063	5,262	5,536	5,288	5,413	6,381	7,592	6,553
Wgtd. Mean	$5,324	5,478	5,956	5,543	5,612	6,598	8,948	10,809

a/ The numbers in parentheses indicate the number of cases included in each mean.

Equation for predicting mean return to capital and family labor based upon this Table: $Y = 5618.46875 + (-460.51367 \times X) + (97.79718 \times X^2)$.

The strength of the relationship implied in the prediction equation: R^2 - .311.

Table 45. INDEXED MEAN RETURN TO CAPITAL AND FAMILY LABOR BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FROM 1959-1965

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100	101	106	105	115	168		
	(106)[a/]	(76)	(52)	(38)	(30)	(11)		
1960	100	79	92	84	87	130	81	
	(91)	(68)	(42)	(32)	(33)	(30)	(3)	
1961	100	134	126	99	101	131	129	
	(92)	(61)	(57)	(37)	(28)	(50)	(7)	
1962	100	102	118	115	94	103	84	
	(137)	(69)	(43)	(48)	(34)	(48)	(26)	
1963	100	103	102	115	96	89	284	21
	(231)	(102)	(60)	(42)	(45)	(51)	(47)	(2)
1964	100	86	74	88	109	94	92	108
	(222)	(165)	(85)	(54)	(36)	(60)	(58)	(3)
1965	100	129	147	123	145	182	159	215
	(329)	(169)	(129)	(79)	(46)	(65)	(59)	(20)
Mean	100	104	109	109	107	126	149	129
Wgtd. Mean	100	103	112	104	105	124	168	203

[a/] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean return to capital and family labor index based upon this Table: $Y = 0.07217 + (-0.05595 \times X) + (0.01381 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .313$.

Table 46. MEAN RETURN TO CAPITAL AND FAMILY LABOR BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS ENROLLED IN WELL-ORGANIZED ADULT PROGRAMS

Year	Years of Participation 1	2	3	4	5	6.5	9	12.5
1959	\$2,854 (45)[a]	3,672 (17)	3,788 (7)	4,164 (12)	3,752 (11)	8,525 (3)		
1960	\$5,980 (36)	4,866 (31)	4,981 (17)	2,367 (4)	4,502 (11)	9,461 (13)		
1961	\$4,883 (43)	7,404 (30)	7,256 (27)	5,577 (12)	2,759 (4)	5,514 (20)	9,787 (2)	
1962	\$4,261 (59)	4,601 (32)	6,409 (27)	7,056 (21)	5,793 (11)	3,955 (15)	2,745 (12)	
1963	\$5,769 (88)	5,951 (48)	6,178 (29)	6,808 (26)	6,383 (18)	5,737 (16)	38,117 (16)	
1964	\$6,072 (92)	3,590 (72)	4,977 (45)	5,238 (25)	6,168 (23)	6,778 (25)	5,473 (19)	5,750 (2)
1965	\$6,077 (124)	7,347 (86)	8,216 (62)	7,436 (44)	8,501 (21)	12,813 (37)	7,233 (22)	16,629 (10)
Mean	\$5,128	5,347	5,972	5,521	5,408	7,540	12,671	11,897
Wgtd. Mean	\$5,390	5,565	6,508	6,317	6,069	8,166	15,172	14,816

[a] The numbers in parentheses indicate the number of cases included in each mean.

Equation for predicting mean return to capital and family labor based upon this Table: $Y = 5901.78125 + (-757.86816 \times X) + (177.97191 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .229$.

Table 47. INDEXED MEAN RETURN TO CAPITAL AND FAMILY LABOR BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS ENROLLED IN WELL-ORGANIZED ADULT PROGRAMS

	Years of Participation							
Year	1	2	3	4	5	6.5	9	12.5
1959	100 (45)[a]	129 (17)	133 (7)	146 (12)	131 (11)	299 (3)		
1960	100 (36)	81 (31)	83 (17)	40 (4)	75 (11)	158 (13)		
1961	100 (43)	152 (30)	149 (27)	114 (12)	57 (4)	113 (20)	200 (2)	
1962	100 (59)	108 (32)	150 (27)	166 (21)	136 (11)	93 (15)	64 (12)	
1963	100 (88)	103 (48)	107 (29)	118 (26)	111 (18)	99 (16)	661 (16)	
1964	100 (92)	59 (72)	82 (45)	86 (25)	102 (23)	112 (25)	90 (19)	95 (2)
1965	100 (124)	121 (86)	135 (62)	122 (44)	140 (21)	211 (37)	119 (22)	274 (10)
Mean	100	104	116	198	105	147	247	232
Wgtd. Mean	100	103	121	117	113	152	281	275

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean return to capital and family labor index based upon this Table: $Y = 0.68342 + (0.14599 \times X)$.

The strength of the relationship implied in the prediction equation: $R^2 = .143$.

Table 48. INDEXED RETURN TO CAPITAL BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS WITH LESS THAN TWELVE YEARS OF FORMAL EDUCATION

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (26)[a]	81 (9)	103 (13)	43 (5)	99 (7)			
1960	100 (12)	67 (18)	72 (6)	63 (6)	41 (5)	65 (7)		
1961	100 (29)	151 (11)	147 (10)	13 (5)	87 (6)	66 (7)		
1962	100 (28)	111 (21)	114 (7)	145 (10)	90 (6)	97 (10)	76 (7)	
1963	100 (48)	115 (26)	116 (22)	113 (7)	92 (9)	109 (10)	80 (8)	
1964	100 (40)	77 (30)	67 (20)	98 (20)	91 (7)	99 (13)	46 (12)	
1965	100 (96)	132 (35)	135 (20)	114 (19)	135 (18)	197 (14)	135 (11)	183 (6)
Mean	100	105	108	84	91	106	84	183
Wgtd. Mean	100	106	108	98	101	114	84	183

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean return to capital index based upon this Table: $Y = -427.64 + (956.64 \times X) + (-583.20 \times X^2) + (156.26 \times X^3) + (-19.038 \times X^4) + (.8634 \times X^5)$.

The strength of the relationship implied in the prediction equation: $R^2 = .22$.

Table 49. INDEXED RETURN TO CAPITAL BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS WITH TWELVE OR MORE YEARS OF FORMAL EDUCATION

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100	87	95	101	115	172		
	(47)[a]	(34)	(21)	(19)	(16)	(5)		
1960	100	78	86	104	89	188		
	(33)	(32)	(25)	(16)	(14)	(15)		
1961	100	140	106	100	111	150		
	(44)	(26)	(29)	(22)	(13)	(22)		
1962	100	87	115	102	91	98	77	
	(81)	(38)	(23)	(24)	(19)	(21)	(12)	
1963	100	100	89	122	91	88	107	
	(138)	(60)	(29)	(26)	(25)	(30)	(23)	
1964	100	107	81	98	133	94	128	
	(128)	(102)	(52)	(25)	(23)	(35)	(32)	
1965	100	117	139	144	163	176	155	252
	(163)	(92)	(84)	(48)	(21)	(41)	(34)	(10)
Mean	100	102	102	110	113	138	117	252
Wgtd. Mean	100	104	108	115	115	131	126	252

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed mean total farm sales based upon this Table: $Y = -131.84 + (63.191 \times X) + (-11.274 \times X^2) + (.68968 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .37$.

Table 50. INDEXED MEAN RETURN TO CAPITAL BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS HAVING LESS THAN $30,000 CAPITAL DURING FIRST RECORD ANALYSIS YEAR

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (49)a/							
1960	100 (40)	89 (29)						
1961	100 (47)	140 (28)	96 (21)					
1962	100 (49)	107 (33)	111 (20)	105 (19)				
1963	100 (79)	132 (39)	123 (31)	130 (17)	144 (17)			
1964	100 (73)	89 (47)	103 (31)	130 (25)	139 (13)	111 (14)		
1965	100 (131)	202 (63)	183 (35)	148 (31)	216 (23)	234 (23)		
Mean	100	127	123	128	166	173		
Wgtd. Mean	100	134	128	131	174	188		

a/ The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed return to capital based upon this Table: $Y = 89.12312 + (13.294 \times X)$.

The strength of the relationship implied in the prediction equation: $R^2 = .89$.

Table 51. INDEXED RETURN TO CAPITAL BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS HAVING $30,000-$59,999 IN CAPITAL DURING FIRST RECORD ANALYSIS YEAR

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (31)a/							
1960	100 (30)	109 (20)						
1961	100 (26)	99 (17)	109 (17)					
1962	100 (53)	118 (21)	172 (13)	126 (16)				
1963	100 (91)	101 (39)	143 (15)	127 (12)	109 (15)			
1964	100 (72)	130 (59)	86 (30)	113 (9)	161 (10)	109 (11)		
1965	100 (102)	107 (57)	120 (52)	108 (26)	194 (8)	169 (22)		
Mean	100	111	126	119	155	139		
Wgtd. Mean	100	113	119	117	160	149		

a/ The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed mean return to capital based upon this Table: $Y = 91.46 + (9.60 \times X)$.

The strength of the relationship implied in the prediction equation: $R^2 = .33$.

Table 52. INDEXED RETURN TO CAPITAL BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS HAVING CAPITAL OF $60,000 AND MORE DURING FIRST RECORD ANALYSIS YEAR

	Years of Participation							
Year	1	2	3	4	5	6.5	9	12.5
1959	100							
	(18)[a]							
1960	100	43						
	(12)	(10)						
1961	100	219	249					
	(16)	(10)	(8)					
1962	100	108	106	188				
	(24)	(11)	(5)	(6)				
1963	100	105	80					
	(52)	(14)	(9)	(4)	(4)			
1964	100	72	34	73				
	(51)	(32)	(10)	(8)	(3)	(4)		
1965	100	124	137	135	92	235		
	(73)	(35)	(26)	(9)	(6)	(7)		
Mean	100	112	121	132	92	235		
Wgtd. Mean	100	106	123	127	92	235		

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed mean total farm returns based upon this Table: $Y = 297.94 + (-439.04 \times X) + (294.79 \times X^2) + (-80.715 \times X^3) + (9.2668 \times X^4) + (-.32047 \times X^5)$.

The strength of the relationship implied in the prediction equation: $R^2 = .49$.

Table 53. MEAN RETURN TO CAPITAL AND FAMILY LABOR BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FOR TWO OR MORE YEARS FROM 1959-1965

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	$3,369 (68)a/	3,442 (75)	3,619 (52)	3,586 (38)	3,941 (30)	5,745 (11)		
1960	$5,971 (60)	4,111 (68)	4,864 (40)	4,391 (32)	4,553 (33)	6,808 (30)		
1961	$5,102 (69)	6,376 (61)	6,011 (57)	4,700 (37)	4,814 (28)	6,228 (50)	6,361 (6)	
1962	$4,892 (98)	4,906 (69)	5,700 (43)	5,569 (48)	4,544 (34)	4,948 (48)	4,064 (26)	
1963	$6,226 (164)	6,170 (99)	5,992 (60)	6,772 (42)	5,657 (45)	5,229 (51)	16,783 (47)	-1,228 (2)
1964	$5,639 (163)	4,436 (163)	4,075 (84)	4,850 (54)	5,967 (36)	5,171 (60)	5,065 (58)	5,933 (3)
1965b/		$7,519 (169)	8,562 (129)	7,150 (79)	8,415 (46)	10,540 (65)	9,248 (59)	12,498 (20)
Mean	$5,200	5,280	5,545	5,288	5,413	6,381	8,304	5,734
Wgtd. Mean	$5,400	5,497	5,972	5,543	5,612	6,598	9,041	10,612

a/ The numbers in parentheses indicate the number of cases included in each mean.

b/ The records for 1965 were not used to compute the prediction equation.

Equation for predicting mean return to capital and family labor based upon this Table: $Y = 6047.00000 + (-838.53613 \times X) + (133.73515 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .194$.

Table 54. INDEXED MEAN RETURN TO CAPITAL AND FAMILY LABOR BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FOR TWO OR MORE YEARS FROM 1959-1965

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (68)[a]	102 (75)	107 (52)	106 (38)	117 (30)	171 (11)		
1960	100 (60)	69 (68)	81 (40)	74 (32)	76 (33)	115 (30)		
1961	100 (69)	125 (61)	118 (57)	92 (37)	94 (28)	122 (50)	125 (6)	
1962	100 (98)	100 (69)	117 (43)	114 (48)	93 (34)	101 (48)	83 (26)	
1963	100 (164)	99 (99)	96 (60)	109 (42)	91 (45)	84 (51)	270 (47)	0 (2)
1964	100 (163)	79 (163)	72 (84)	86 (54)	106 (36)	92 (60)	90 (58)	105 (3)
1965[b]								
Mean	100	102	107	102	104	123	160	110
Wgtd. Mean	100	102	111	103	104	122	167	197

[a] The numbers in parentheses indicate the number of cases included in each mean index.

[b] The records for 1965 were not used to compute the prediction equation.

Equation for predicting mean return to capital and family labor index based upon this Table: $Y = 1.10248 + (-0.10867 \times X) + (0.01849 \times X^2)$.

The strength of the relationship implied in the prediction equation: $R^2 = .178$.

Table 55. MEAN LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FROM 1959-1965

	Years of Participation							
Year	1	2	3	4	5	6.5	9	12.5
1959	$1,616 (106)a/	1,736 (76)	2,053 (52)	1,945 (38)	1,920 (30)	2,605 (11)		
1960	$3,394 (91)	2,248 (68)	2,856 (42)	3,109 (32)	2,793 (33)	4,369 (30)	473 (3)	
1961	$3,038 (92)	4,547 (61)	4,161 (57)	3,126 (37)	3,520 (28)	4,400 (50)	4,215 (7)	
1962	$2,903 (137)	3,234 (69)	3,768 (43)	3,769 (48)	3,009 (34)	3,222 (48)	1,956 (26)	
1963	$3,976 (231)	4,168 (102)	4,175 (61)	4,713 (42)	3,899 (45)	3,715 (51)	4,340 (48)	-3,485 (2)
1964	$3,293 (222)	2,539 (166)	2,152 (85)	2,680 (54)	3,741 (36)	3,075 (60)	3,190 (58)	2,845 (3)
1965	$4,026 (329)	5,429 (169)	6,501 (129)	5,326 (79)	6,170 (46)	7,981 (65)	7,183 (59)	11,012 (20)
Mean	$3,311	3,415	3,667	3,524	3,579	4,195	3,559	5,781
Wgtd. Mean	$3,591	3,586	4,056	3,744	3,748	4,530	4,472	9,430

a/ The numbers in parentheses indicate the number of cases included in each mean.

Equation for predicting mean labor earnings based upon this Table: $Y = 2080.68506 + (1260.48242 \times X) + (-312.57886 \times X^2) + (24.40436 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .392$.

Table 56. INDEXED MEAN LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - ALL FARMERS ENROLLED FROM 1959-1965

	Years of Participation							
Year	1	2	3	4	5	6.5	9	12.5
1959	100	107	127	120	119	161		
	(106)a/	(76)	(52)	(38)	(30)	(11)		
1960	100	66	84	92	82	129	14	
	(91)	(68)	(42)	(32)	(33)	(30)	(3)	
1961	100	150	137	103	116	145	139	
	(92)	(61)	(57)	(37)	(28)	(50)	(7)	
1962	100	111	130	130	104	111	67	
	(137)	(69)	(43)	(48)	(34)	(48)	(26)	
1963	100	105	105	119	98	93	109	-88
	(231)	(102)	(61)	(42)	(45)	(51)	(48)	(2)
1964	100	77	65	81	114	93	97	86
	(222)	(166)	(85)	(54)	(36)	(60)	(58)	(3)
1965	100	135	161	132	153	198	178	274
	(329)	(169)	(129)	(79)	(46)	(65)	(59)	(20)
Mean	100	103	111	106	108	127	108	175
Wgtd. Mean	100	100	113	104	104	126	125	263

a/ The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean labor earnings index based upon this Table: $Y = 0.70409 + (0.33734 \times X) + (-0.07874 \times X^2) + (0.00580 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .409$.

Table 57. MEAN LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS ENROLLED IN WELL-ORGANIZED ADULT PROGRAMS

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	$1,197 (45)a/	2,442 (18)	2,368 (7)	2,276 (12)	1,503 (11)	2,620 (3)		
1960	$3,492 (36)	3,161 (31)	2,708 (17)	2,118 (4)	2,342 (11)	6,167 (13)		
1961	$3,346 (43)	5,372 (30)	5,604 (27)	3,591 (12)	2,345 (4)	3,741 (20)	6,422 (2)	
1962	$2,226 (59)	3,199 (32)	4,105 (27)	5,267 (21)	3,934 (11)	2,122 (15)	805 (12)	
1963	$3,990 (88)	4,337 (48)	4,412 (29)	4,457 (26)	4,365 (18)	4,218 (16)	5,560 (17)	
1964	$3,635 (92)	2,208 (73)	3,018 (45)	3,172 (25)	3,727 (23)	4,499 (25)	4,024 (19)	1,963 (2)
1965	$4,366 (124)	5,444 (86)	6,337 (62)	5,561 (44)	6,669 (21)	10,034 (37)	5,416 (22)	15,938 (10)
Mean	$3,179	3,738	4,079	3,777	3,555	4,772	4,445	8,951
Wgtd. Mean	$3,453	3,909	4,586	4,370	4,033	5,782	4,342	13,609

a/ The numbers in parentheses indicate the number of cases included in each mean.

Equation for predicting mean labor earnings based upon this Table: $Y = 1140.87500 + (2396.21094 \times X) + (-596.86426 \times X^2) + (44.98703 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .510$.

Table 58. INDEXED MEAN LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS ENROLLED IN WELL-ORGANIZED ADULT PROGRAMS

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (45)a/	204 (18)	198 (7)	190 (12)	126 (11)	219 (3)		
1960	100 (36)	91 (31)	78 (17)	61 (4)	67 (11)	177 (13)		
1961	100 (43)	161 (30)	167 (27)	107 (12)	70 (4)	112 (20)	192 (2)	
1962	100 (59)	144 (32)	184 (27)	237 (21)	177 (11)	95 (15)	36 (12)	
1963	100 (88)	109 (48)	111 (29)	112 (26)	109 (18)	106 (16)	139 (17)	
1964	100 (92)	61 (73)	83 (45)	87 (25)	103 (23)	124 (25)	111 (19)	54 (2)
1965	100 (124)	125 (86)	145 (62)	127 (44)	153 (21)	230 (37)	124 (22)	365 (10)
Mean	100	118	128	119	112	150	140	282
Wgtd. Mean	100	113	133	109	117	167	126	394

a/ The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean labor earnings index based upon this Table: $Y = 0.32731 + (0.82298 \times X) + (-0.19482 \times X^2) + (0.01330 \times X^3)$.

The strength of the relationship implied in the prediction equation: $R^2 = .404$.

Table 59. INDEXED LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS HAVING TWELVE OR MORE YEARS OF FORMAL EDUCATION

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (47)[a]	94 (34)	112 (21)	141 (19)	143 (16)	209 (5)		
1960	100 (34)	57 (32)	92 (25)	133 (16)	91 (14)	227 (15)	(2)	
1961	100 (44)	156 (26)	103 (29)	105 (22)	121 (13)	164 (22)	(2)	
1962	100 (81)	94 (38)	116 (23)	103 (24)	91 (19)	94 (21)	74 (12)	
1963	100 (138)	107 (60)	92 (29)	124 (26)	85 (25)	87 (30)	108 (23)	
1964	100 (128)	99 (102)	76 (52)	90 (25)	138 (23)	67 (35)	136 (32)	
1965	100 (163)	125 (92)	146 (84)	156 (48)	181 (21)	181 (41)	168 (34)	326 (10)
Mean	100	105	105	122	121	147	122	326
Wgtd. Mean	100	106	111	125	122	133	133	326

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation of predicting return to capital index based upon this Table: $Y = -137.83 + (378.14 \times X) + (-181.86 \times X^2) + (26.192 \times X^3) + (2.8964 \times X^4) + (-1.0161 \times X^5) + (.065694 \times X^6)$.

The strength of the relationship implied in the prediction equation: $R^2 = .998$.

Table 60. INDEXED LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS HAVING LESS THAN $30,000 CAPITAL DURING FIRST RECORD ANALYSIS YEAR

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (49)[a]							
1960	100 (40)	73 (29)						
1961	100 (47)	152 (28)	87 (21)					
1962	100 (49)	85 (33)	87 (20)	91 (19)				
1963	100 (79)	135 (39)	103 (31)	112 (17)	136 (17)			
1964	100 (73)	75 (47)	87 (31)	104 (25)	108 (13)	89 (14)		
1965	100 (131)	208 (63)	204 (35)	155 (31)	209 (23)	227 (23)		
Mean	100	121	114	116	151	158		
Wgtd. Mean	100	130	120	120	161	175		

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting indexed mean labor earnings based upon this Table: $Y = 91.35 + (9.86 \times X)$.

The strength of the relationship implied in the prediction equation: $R^2 = .13$.

Table 61. INDEXED LABOR EARNINGS BY CALENDAR YEAR AND PARTICIPATION IN ADULT FARM BUSINESS MANAGEMENT EDUCATION - FARMERS HAVING CAPITAL OF $30,000-$59,999 DURING FIRST RECORD ANALYSIS YEAR

Year	Years of Participation							
	1	2	3	4	5	6.5	9	12.5
1959	100 (31)[a]							
1960	100 (30)	128 (20)						
1961	100 (26)	97 (17)	115 (17)					
1962	100 (53)	152 (21)	222 (13)	147 (16)				
1963	100 (91)	99 (39)	152 (15)	122 (12)	110 (15)			
1964	100 (72)	133 (59)	78 (30)	97 (9)	180 (10)	98 (11)		
1965	100 (102)	113 (57)	126 (52)	111 (26)	225 (8)	183 (22)		
Mean	100	120	139	119	172	141		
Wgtd. Mean	100	120	126	120	159	155		

[a] The numbers in parentheses indicate the number of cases included in each mean index.

Equation for predicting mean return to capital based upon this Table: $Y = 94.60 + (10.83 \times X)$.

The strength of the relationship implied in the prediction equation: $R^2 = .21$.

APPENDIX C

OE 6000 (9-65)

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OFFICE OF EDUCATION
WASHINGTON 25, D.C.
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15. ABSTRACT *(250 words max.)*

The purpose of the research was to determine (1) the absolute economic return to adult farm business management education, (2) the diminishing marginal return effect from added increments of education, and (3) the benefit-cost ratio of the educational program for participants and for the sponsoring community.

Data were collected from 3,578 farm business record analyses completed through the adult education programs of vocational agriculture departments in Minnesota public schools. All farmers enrolled in farm business management education in 1959-1965 were included. A sub-sample of records from adult programs judged by experts to be "well-organized" was used to compute benefit-cost ratio.

Descriptive statistical measures described the sample in relation to farm operators as defined by Agricultural Census. Farmers participating in the education program were younger, better educated, and more affluent than the average farmer described in census data.

Polynomial curvilinear regression statistical techniques described the relationship between investment in farm business management education and three measures of economic success--operator's labor earnings, return to capital and family labor, and total farm sales.

Operators' labor earnings increased rapidly during the first three years of instruction, declined for the fourth, fifth and sixth years and then increased rapidly in subsequent years. The same general relationship was shown for farm sales.

The benefit-cost ratio for individual farmer participants was 4.20:1. The community benefit-cost ratio when increased business activity is measured by increased farm sales was 9.00:1.

16. RETRIEVAL TERMS *(Continue on reverse)*

Achievement Gains
Adult Education
Adult Farmer Education
Adult Vocational Education
Agricultural Education
Curriculum Evaluation
Effective Programs

Evaluation
Economics of Education
Farm Management
Farmers
Program Evaluation
Vocational Agriculture
Young Farmer Education

17. IDENTIFIERS

N.A.

VARIETIES ELIGIBLE FOR CERTIFICATION IN MINNESOTA

1968

BARLEY

Conquest
Dickson
Larker
Primus

BIRDSFOOT TREFOIL

Empire
Dawn

BLUEGRASS

C-1
Merion
Newport
Park

BROMEGRASS

Achenbach
Fischer
Lincoln
Sac
Saratoga

CLOVER--BIENNIAL SWEET

Evergreen
Goldtop
Madrid

CLOVER--MEDIUM RED

Dollard
Lakeland
Pennscott

CORN--FIELD

Minhybrids and other open-pedigree hybrids for which crossing stocks are available from the Minnesota Agricultural Experiment Station.

Closed pedigree hybrids on basis of affidavit from producer

CROWNVETCH

Emerald
Penngift

FIELD PEAS

Chancellor
Century
Strål

FLAX

B-5128
Bolley
Nored
Redwood
Summit
Windom

MILLET

Empire
Turghai
White Wonder

OATS

Ajax
Beedee
Burnett
Cherokee
Clintford
Clintland-64
Dawn
Garland
Gary
Goodfield
Harmon
Holden
Jaycee
Kelsey
Lodi
Minhafer
Nemaha
Orbit
O'Brien
Portal
Red River 68
Rodney
Santee
Sioux
Stormont
Tippecanoe
Tyler
Wyndmere

RYE

Caribou
Elk
Frontier
Pearl
Von Lochow

SOYBEANS

Altona
Amsoy
A-100
Blackhawk
Chippewa-64
Clay
Comet
Corsoy
Disoy
Flambeau
Grant
Hark
Harosoy-63
Lindarin-63
Merit
Ottawa Mandarin
Portage
Traverse

SUNFLOWERS

Arrowhead
Mingren
Peredovik

TIMOTHY

Clair
Climax
Essex
Itasca
Lorain

WHEAT--DURUM

Lakota
Leeds
Wells

WHEAT--SPRING

Chris
Manitou
Polk
Rushmore
Sheridan

WHEAT--WINTER

Hume
Minter

Eligible for certification in 1968 only. Future eligibility will depend on recommendation by the Minnesota Agricultural Experiment Station or approval by the Minnesota Crop Improvement Association.